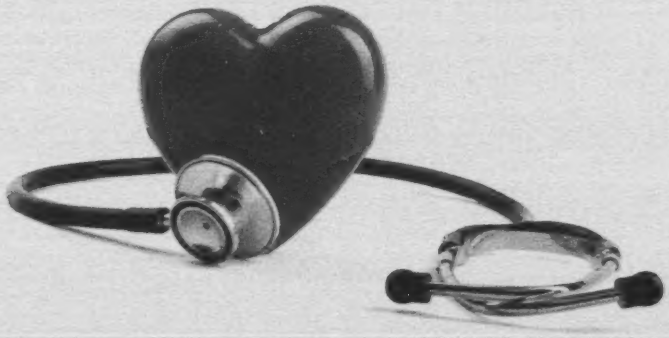
REPORT FROM THE CANADIAN CHRONIC DISEASE SURVEILLANCE SYSTEM:

HEART DISEASE IN CANADA, 2018



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EXECUTIVE SUMMARY

HEART DISEASES

In Canada, heart disease is the second leading cause of death, after cancer, and accounted for almost 20% of all deaths in 2012. Also known as ischemic heart disease or coronary heart disease, heart disease refers to the buildup of plaque in the heart's arteries that could lead to a heart attack, a stroke or heart failure. Heart disease is the most common type of heart conditions in Canada and other industrialized countries, accounting for almost half of all heart-disease-related deaths.

PURPOSE OF THIS REPORT

This report is the first publication to include administrative health data from the Canadian Chronic Disease Surveillance System to support the national surveillance of ischemic heart disease and acute myocardial infarction (a subset of ischemic heart disease also known as heart attack) among Canadian adults aged 20 years and older as well as heart failure among Canadian adults aged 40 years and older. It features the most recent data available from the surveillance system (fiscal year 2012–2013), as well as trend data spanning over a decade.

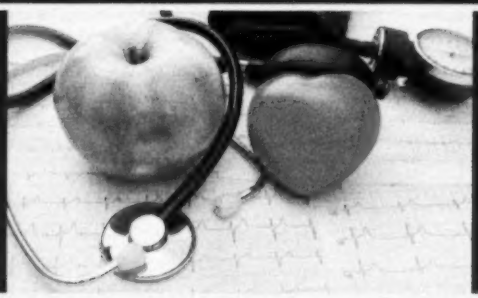
KEY FINDINGS

In 2012–2013, about 2.4 million (or 1 in 12) Canadian adults aged 20 years and older were living with ischemic heart disease, including 578,000 with a history of an acute myocardial infarction. Another 669,600 (3.6%) Canadians adults aged 40 years and older were living with heart failure.

- **Heart disease outcomes are improving over time.** From 2000–2001 to 2012–2013, age-standardized ischemic heart disease and heart failure incidence and all-cause mortality rates declined, while the prevalence of both conditions remained relatively stable. Respectively, incidence rates declined by 45% and 35% and all-cause mortality rates fell by 24% and 26%. A similar pattern was observed for acute myocardial infarction, although the occurrence increased by about 67% over the study period.

- **Rates of death from any cause are higher among those with a heart disease than those without.** Canadian adults with ischemic heart disease (IHD) were three times more likely to die of any cause compared to those without the disease in a given year. The outcome was least favorable for younger women and men aged 20 to 39 years old with ischemic heart disease who were about 18 and 11 times more likely to die of any cause, respectively, than individuals of the same age without IHD. Overall, individuals with a history of an acute myocardial infarction and those with heart failure were four and six times more likely to die of any cause than those with neither condition in a given year.
- **Heart disease differs by sex.** Heart disease appears about 10 years later in women than in men. In addition, age-standardized prevalence and incidence rates of diagnosed ischemic heart disease and heart failure as well as the occurrence of acute myocardial infarction were higher among men than women over the 13-year period. Similarly, age-standardized all-cause mortality rates were higher in men than women, except for acute myocardial infarction where women aged 45 to 74 years old were about 30% more likely to die of any cause than men of the same age in a given year.

Although remarkable advancements in the prevention and management of heart disease have been made in the last few decades, sustained efforts are needed to further prevent the development of heart disease risk factors, ensure early detection and treatment, and close the gap in disease occurrence between women and men. Finally, the absolute number of people living with a heart condition is increasing, thus the need for management and treatment resources for heart disease will continue to be high.



1. INTRODUCTION

1.1 GLOBAL BURDEN OF HEART DISEASE

Heart disease is the leading cause of death globally. In 2015, an estimated 8.9 million people died from heart disease, which represent 45% of all non-communicable disease deaths worldwide.[1] In addition, heart disease is the leading cause of disability-adjusted life years (DALYs) lost due to ill-health, disability or early death worldwide.[2]

In Canada, although major improvements in treatment, disease management and public health interventions have been made over the last few decades, heart disease is the second leading cause of death,[3] after cancer and a leading cause of hospitalization.[4] Moreover, in Canada, heart disease is the number one cause of years of life lost[1] due to premature mortality and second leading cause of DALYs lost in 2015.[2]

45%of all non-communicable disease deaths worldwide are due to heart disease

8.9 Million

DEATHS GLOBALLY ATTRIBUTABLE TO HEART DISEASE

1.2 DEFINING HEART DISEASE

Also known as coronary heart disease or **ischemic heart disease** (IHD), heart disease is a condition in which the heart muscle is damaged or does not function properly. Plaque (composed of fat, cholesterol, calcium and other substances) builds up on the inner walls of coronary arteries and, over time, it can harden or rupture. When plaque hardens, coronary arteries get narrower and it reduces the flow of blood to the heart muscle which may cause chest pain or discomfort, called angina. When plaque ruptures, a blood clot can form in a coronary artery and block blood flow to the heart, causing an **acute myocardial infarction** (AMI), also known as heart attack. Similarly, a stroke may occur when blood flow to the brain is interrupted or reduced. It happens when a brain blood vessel ruptures or when it is blocked.

Heart disease can also lead to **heart failure** and other types of heart disease, such as cardiac arrhythmias (abnormal heart rhythm).[5] Heart failure occurs when the pumping action of the heart cannot provide enough blood to the rest of the body. It results in an accumulation of fluid in the body, particularly in the lungs or legs.[6] The most common cause of heart failure is damage to the heart muscle as a result of acute myocardial infarction.

1.3 STAGES IN THE DEVELOPMENT OF HEART DISEASE

Heart disease develops over decades. A number of events occur before it progresses to end-stage heart failure. Behavioural risk factors such as unhealthy diet, physical inactivity, smoking, alcohol use and a number of medical risk conditions (e.g. hypertension, diabetes, obesity and high cholesterol) increase a person's risk of developing heart disease later in life. Without early detection, lifestyle modification and/or treatment, these risk factors may contribute to heart failure or death as depicted in Figure A below.

FIGURE A. Events leading to heart disease progression

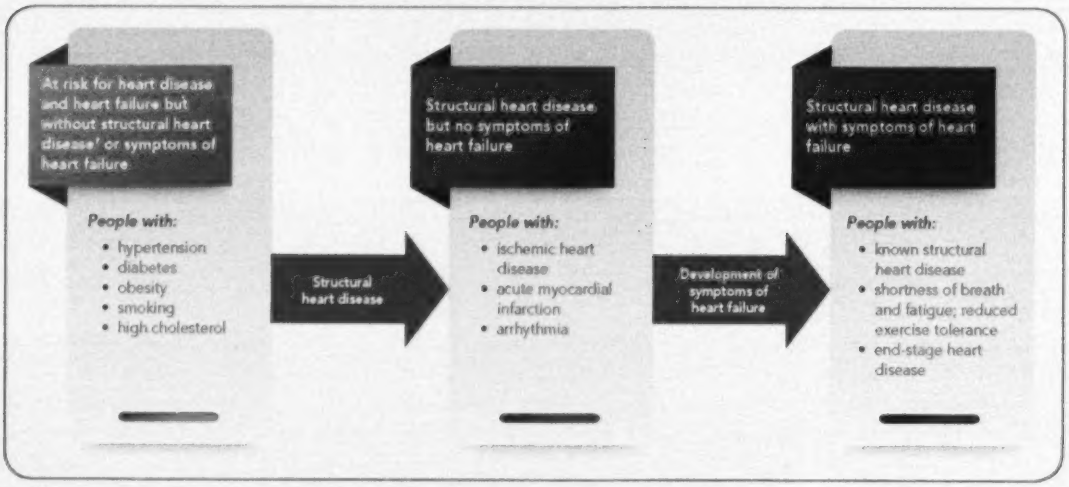

At risk for heart disease and heart failure but without structural heart disease[1] or symptoms of heart failure
People with:
• hypertension
• diabetes
• obesity
• smoking
• high cholesterol
Structural heart disease
Structural heart disease but no symptoms of heart failure
People with:
• ischemic heart disease
• acute myocardial infarction
• arrhythmia
Development of symptoms of heart failure
Structural heart disease with symptoms of heart failure
People with:
• known structural heart disease
• shortness of breath and fatigue; reduced exercise tolerance
• end-stage heart disease

Figure adapted from Jessup M. et al[5] and Dzau VJ et al.[6]

[1] Structural heart disease refers to a defect or abnormality in the heart's valves, heart muscle or blood vessels that can be present at birth (congenital) or acquired later in life.

1.4 PURPOSE OF THIS REPORT

This is the first report from the Public Health Agency of Canada (PHAC) to include administrative health data from the Canadian Chronic Disease Surveillance System (CCDSS) for the national surveillance of heart disease in Canada. It aims to provide a national picture of the status of heart disease in Canada, in addition to highlighting trends spanning over a decade (2000–2001 to 2012–2013). Using data from the CCDSS, estimates for IHD, as well as AMI [a subset of IHD] and heart failure are described in this report. The CCDSS is a collaborative network of provincial and territorial chronic disease surveillance systems, led by PHAC. Technical and methodological notes about the CCDSS as well as definitions used to identify heart disease cases can be found in Appendices A–D. The data from the CCDSS on IHD, AMI and heart failure, as well as many other chronic conditions can be accessed online through PHAC's Public Health Infobase (https://infobase.phac-aspc.gc.ca).

2. KEY FINDINGS

2.1 IMPROVED CARDIOVASCULAR HEALTH

Based on Canadian Chronic Disease Surveillance System (CCDSS) data from 2000–2001 to 2012–2013, a few common trends were observed for ischemic heart disease (IHD), acute myocardial infarction (AMI) [a subset of IHD] and heart failure. These trends are consistent with those reported in the Public Health Agency of Canada's *Tracking Heart Disease and Stroke in Canada* report from 2009, which indicated that death rates for heart disease have decreased dramatically from 1969 to 2004.[6]

2.1.1 Prevalence[i]

- The age-standardized prevalence of diagnosed IHD, among individuals aged 20 years and older, increased from 7.1% to 8.1% between 2000–2001 and 2004–2005 and then stabilizes (Figure 1A). The average annual percent change (AAPC) in prevalence is less than one percent from 2000–2001 to 2012–2013. In contrast, the percentage of people with a history of AMI[ii] increased from 1.2% in 2000–2001 to 2.0% in 2012–2013, representing an AAPC of 3.7% (Figure 1A).
- The number of people living with IHD continues to increase over time, from about 1.5 million in 2000–2001 to 2.4 million in 2012–2013, including about 578,000 with a history of AMI in 2012–2013 (Figure 1A).
- The age-standardized prevalence of heart failure, among individuals aged 40 years and older, remains stable at about 3.5% (Figure 1B). Similar to IHD, the AAPC in heart failure prevalence is less than one percent from 2000–2001 to 2012–2013. Over the 13-year period, the number of people living with diagnosed heart failure increased from about 467,700 to 669,600.

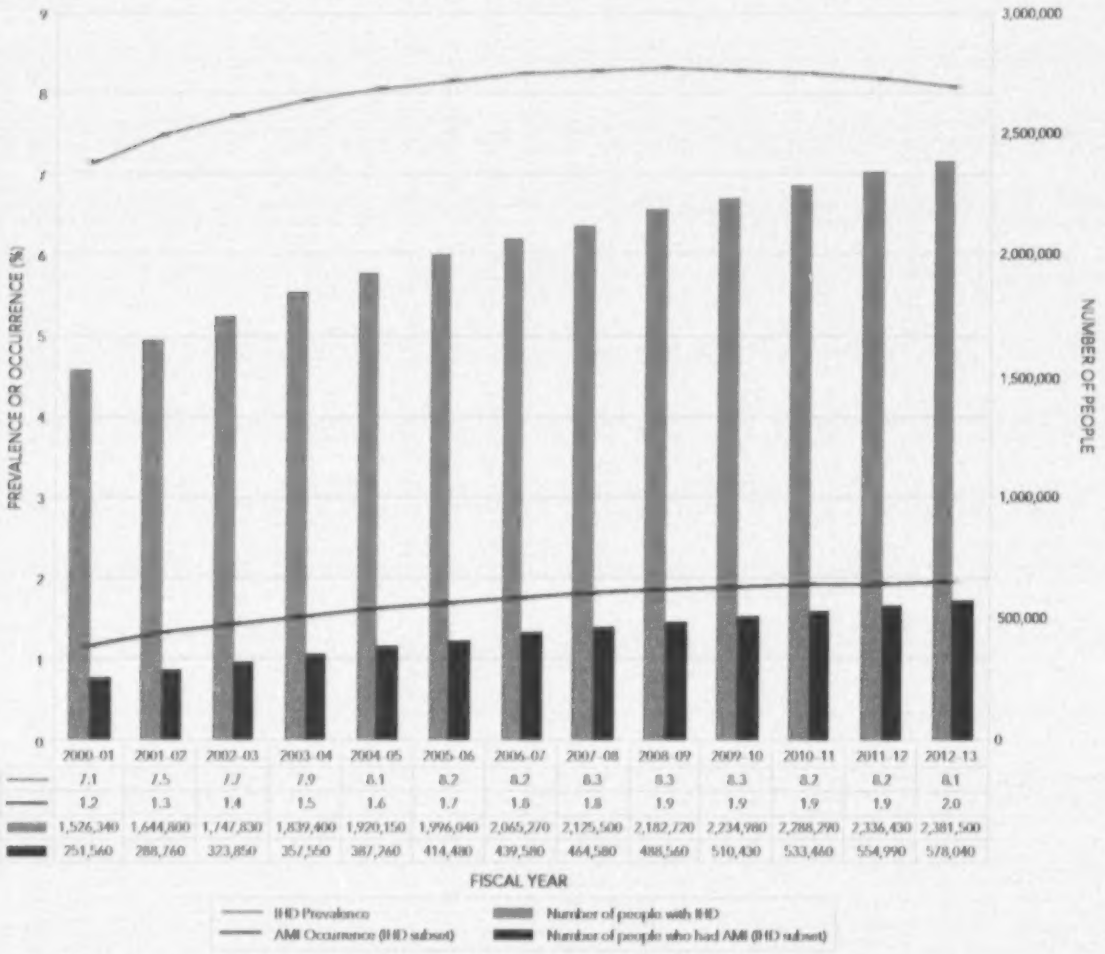
The *number* of Canadian adults aged 20 years and older with a history of heart attack (a subset of heart disease) increased from approximately **251,000** to **578,000** between 2000–2001 and 2012–2013.

The *proportion* of Canadians with a history of heart attack increased by **67%** over the same time period. This increase likely reflects that more and more Canadians are surviving heart attacks.

[i] Counts and crude prevalence and incidence estimates by sex, age group, year, and province/territory can be accessed online through the Public Health Infobase: https://infobase.phac-aspc.gc.ca.

[ii] Individuals aged 20 years and older with a hospital admission including a diagnostic code of AMI or recorded history of AMI were included. More details are available in Appendix B, Table 1.

FIGURE 1A. Prevalence (%[1] and number) of diagnosed ischemic heart disease (IHD) and occurrence (%[1] and number) of acute myocardial infarction (AMI) among Canadians aged 20 years and older, Canada*, 2000–2001 to 2012–2013



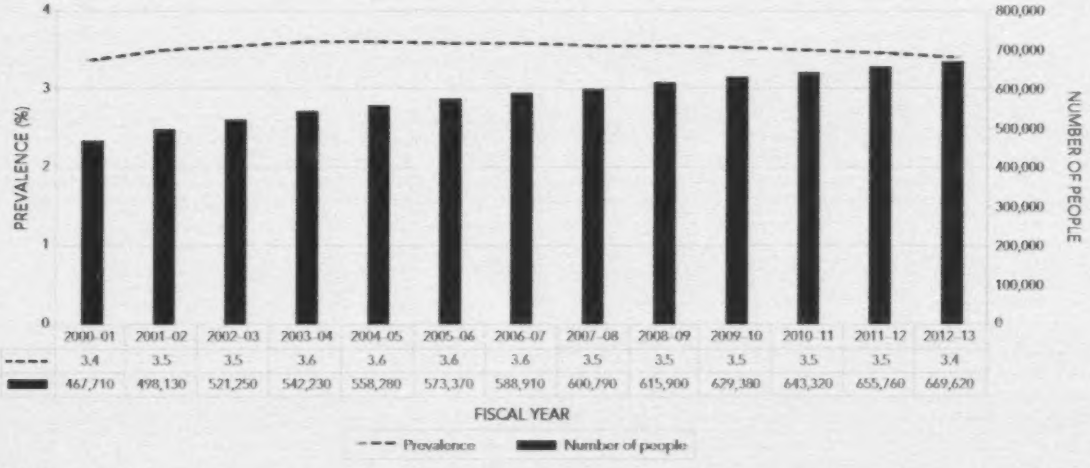
[1] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 1B. Age-standardized[1] prevalence of diagnosed heart failure and number of people with heart failure, among Canadians aged 40 years and older, Canada*, 2000–2001 to 2012–2013



	2000–01	2001–02	2002–03	2003–04	2004–05	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13
Prevalence	3.4	3.5	3.5	3.6	3.6	3.6	3.6	3.5	3.5	3.5	3.5	3.5	3.4
Number of people	467,710	498,130	521,250	542,230	558,780	573,370	588,910	600,790	615,900	629,380	643,320	655,760	669,620

[1] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

2.1.2 Incidence (new cases)

- The age-standardized incidence rate of IHD decreased from 12.3 per 1,000 in 2000–2001 to 6.8 per 1,000 in 2012–2013, with an AAPC of -4.6%. The age-standardized occurrence rate of a first AMI also declined, from 3.0 per 1,000 in 2000–2001 to 2.2 per 1,000 in 2012–2013, with an AAPC of -1.8% (Figure 2A).
- The number of people newly diagnosed with IHD declined from about 221,800 to 158,700 between 2000–2001 and 2012–2013. However, the number of people having a first AMI remained relatively stable at about 62,000 people annually (Figure 2A).
- The age-standardized incidence rate of heart failure declined from 8.1 per 1,000 to 5.3 per 1,000 between 2000–2001 and 2012–2013, with an AAPC of -3.1%. Over the same period, the number of people newly diagnosed with heart failure fell from about 102,800 to 92,900 individuals (Figure 2B).

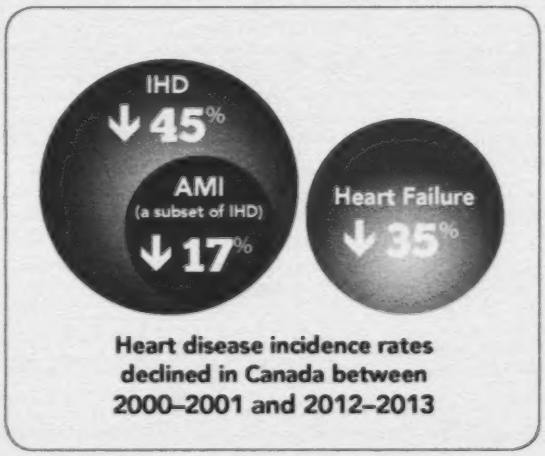
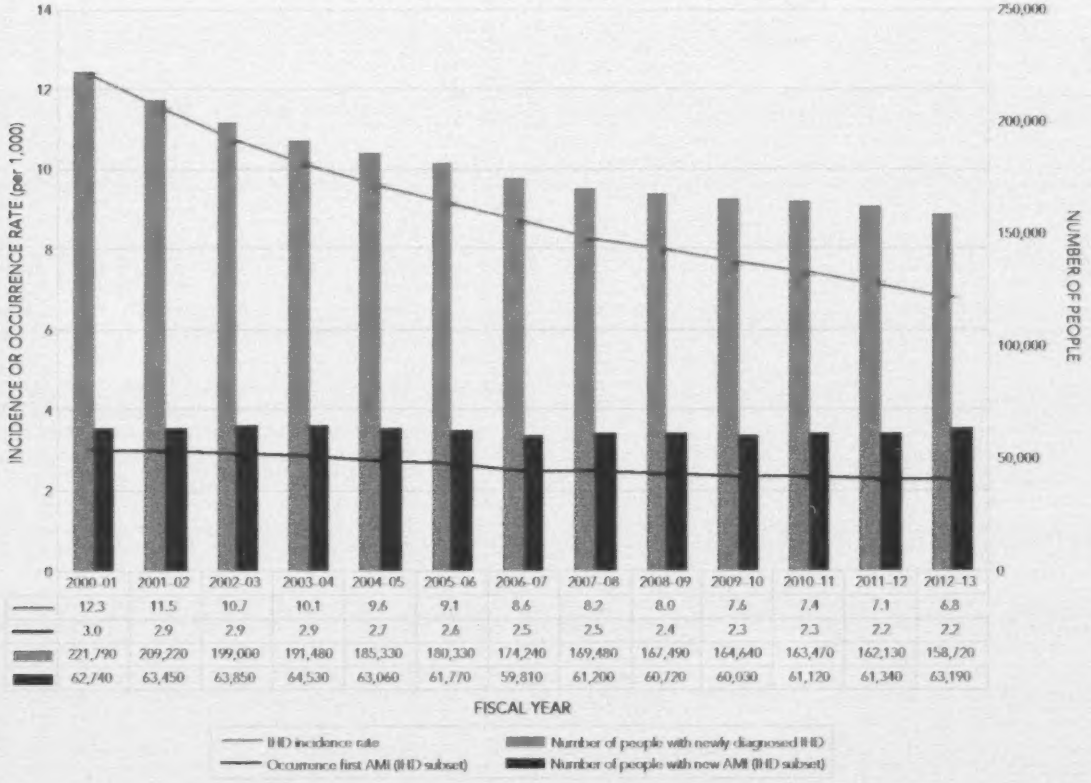


FIGURE 2A. Incidence (rates[1] and number) of diagnosed ischemic heart disease (IHD) and occurrence (rates[1] and number) of first acute myocardial infarction (AMI) among Canadians aged 20 years and older, Canada*, 2000–2001 to 2012–2013



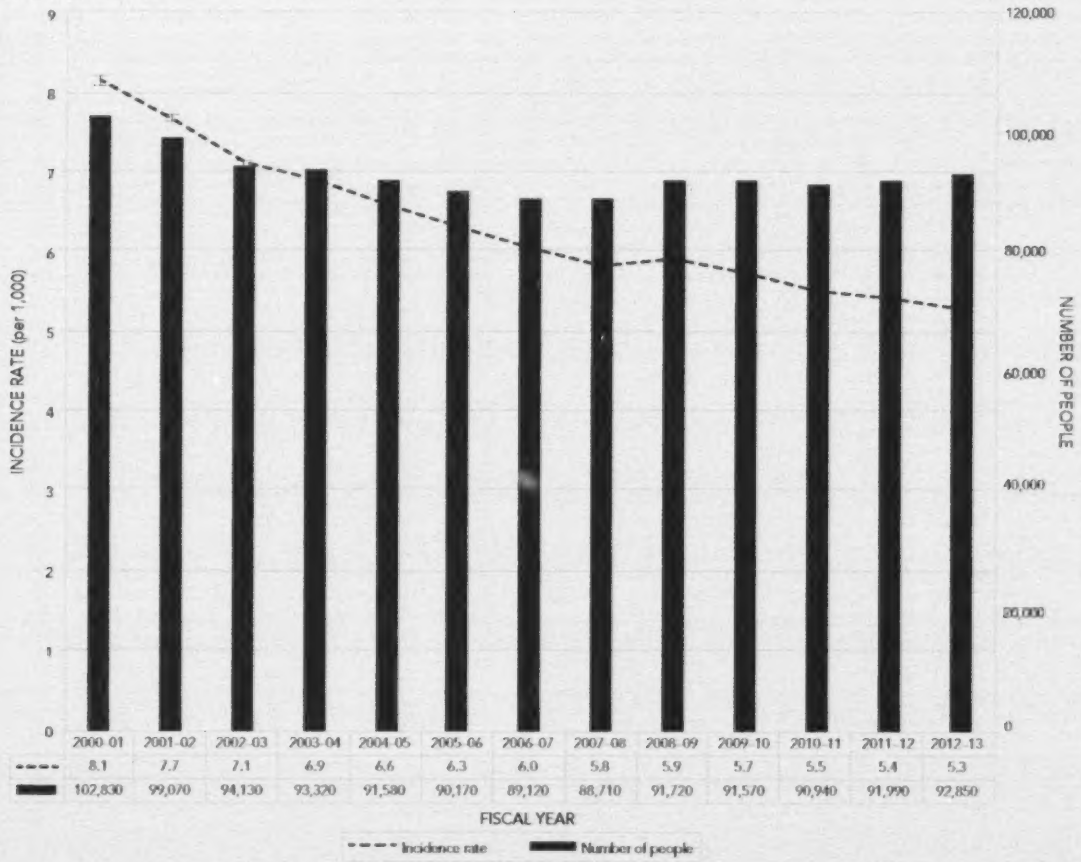
[1] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 2B. Age-standardized[†] incidence rates of diagnosed heart failure and number of people with heart failure, among Canadians aged 40 years and older, Canada*, 2000–2001 to 2012–2013



† Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

2.1.3 All-Cause Mortality Rates

- The age-standardized all-cause mortality rate among people living with IHD and those with a history of AMI decreased substantially between 2000–2001 and 2012–2013, from 22.5 to 17.1 per 1,000 and from 42.2 to 27.5 per 1,000, respectively, with corresponding AAPCs of -1.3% and -2.9% (Figure 3A).
- On the other hand, the absolute number of deaths has increased over time, from about 86,300 deaths in 2000–2001 to 112,200 deaths in 2012–2013 in those with diagnosed IHD, including a rise in the number of deaths among those with a history of AMI, from about 25,600 deaths to 41,500 deaths (Figure 3A). Overall, all-cause deaths among those with a history of AMI represented over one third of all deaths in those with IHD.
- The age-standardized all-cause mortality rate among people living with heart failure declined from 78.4 to 57.8 per 1,000 between 2000–2001 and 2012–2013, with an AAPC of -2.5%. The number of people with heart failure who died of any cause increased from 67,300 in 2000–2001 to 80,100 in 2012–2013 (Figure 3B).

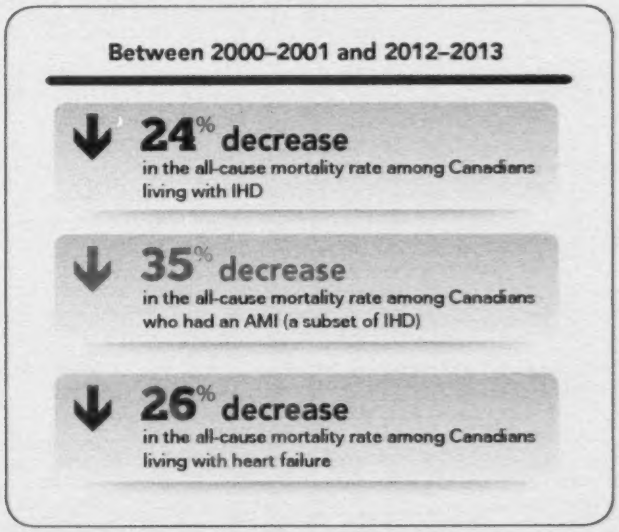
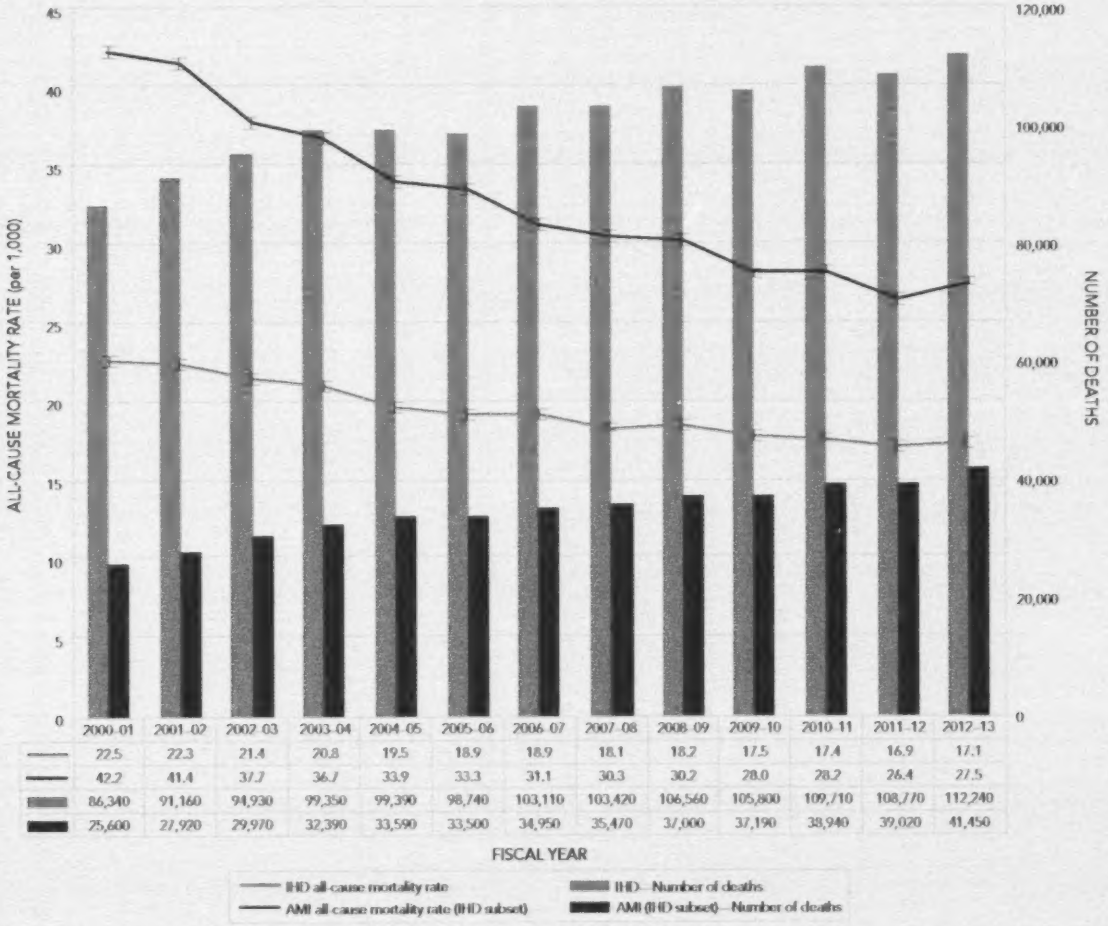

Between 2000–2001 and 2012–2013
24% decrease
in the all-cause mortality rate among Canadians living with IHD
35% decrease
in the all-cause mortality rate among Canadians who had an AMI (a subset of IHD)
26% decrease
in the all-cause mortality rate among Canadians living with heart failure

FIGURE 3A. Age-standardized[†] all-cause mortality rates and number of deaths among Canadians aged 20 years and older with diagnosed ischemic heart disease (IHD) and those who had an acute myocardial infarction (AMI), Canada*, 2000–2001 to 2012–2013



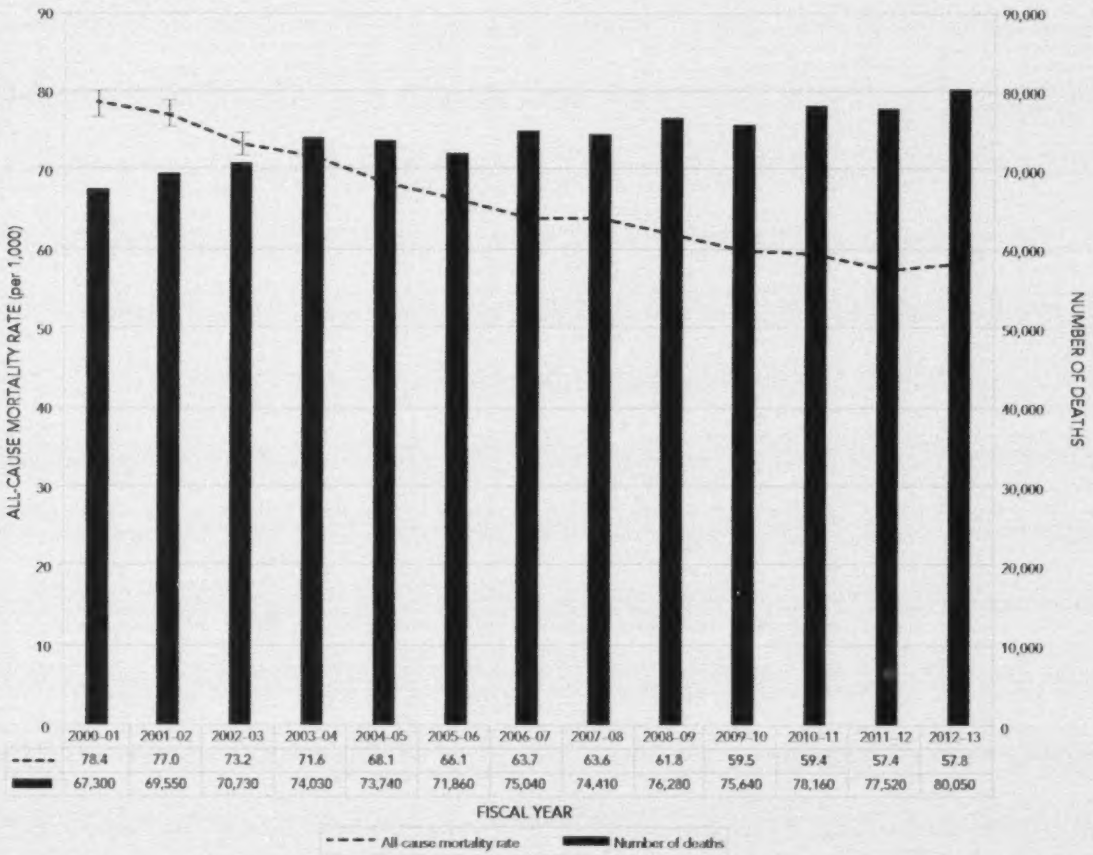
† Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 3B. Age-standardized[†] all-cause mortality rates and number of deaths among Canadians aged 40 years and older with diagnosed heart failure, Canada*, 2000–2001 to 2012–2013



[†] Age-standardized to the 2011 Canadian population.

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SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

CANADIAN ADULTS WITH HEART DISEASE HAVE HIGHER MORTALITY RATES COMPARED TO THOSE WITHOUT HEART DISEASE

- Compared to those without IHD, AMI or heart failure, individuals with the disease of interest are more likely to die of any cause in a given year.
- Age-standardized all-cause mortality rates were almost three times higher, on average, among Canadian adults with diagnosed IHD compared to those without in a given year (Figure 4A).
- Compared to those without a prior history of AMI, those with a history of AMI were about four times more likely to die of any cause in 2012–2013 (Figure 4B). The gap between those with and without a history of AMI has reduced over time, since the rate ratio was as high as 4.7 in the early 2000s.
- In a given year, Canadians aged 40 years and older with diagnosed heart failure were, on average, six times more likely to die of any cause than those without heart failure (Figure 4C).

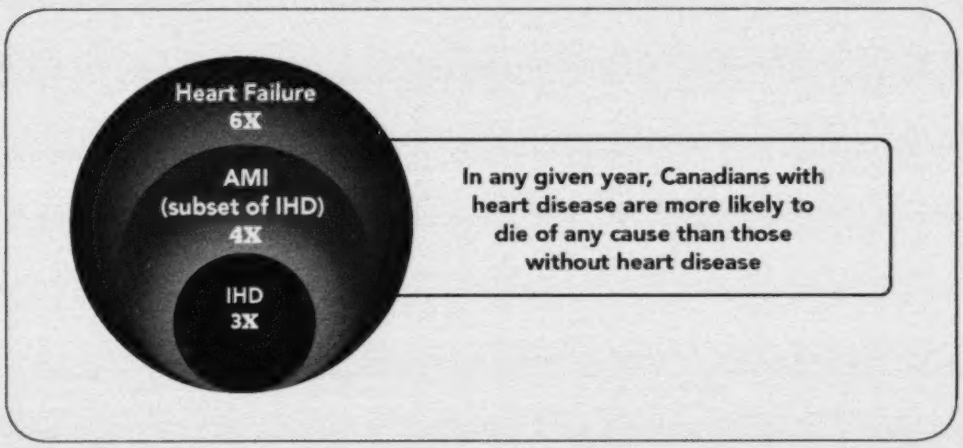
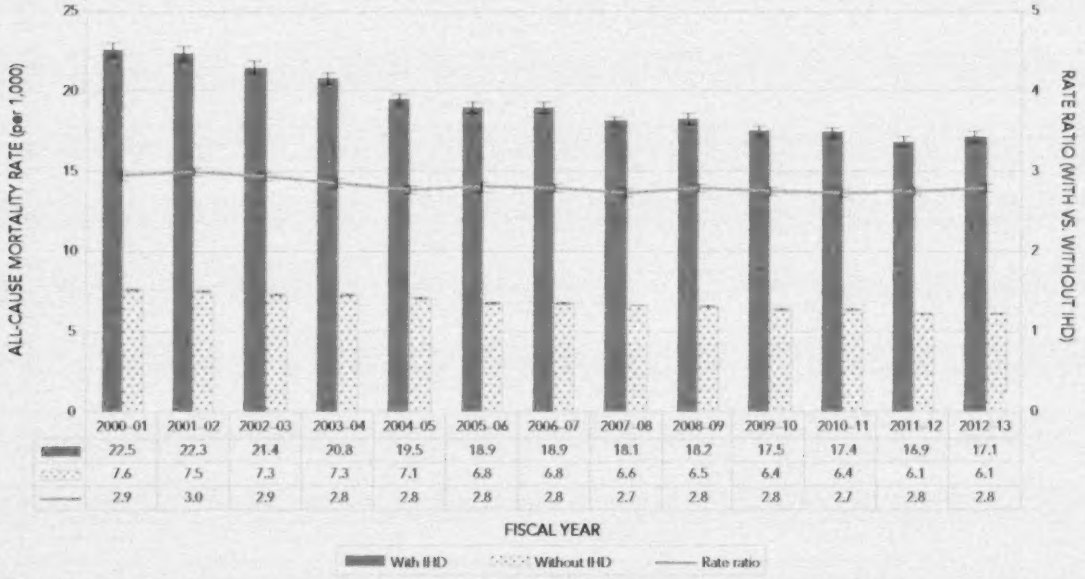


FIGURE 4A. Age-standardized[†] all-cause mortality rates and rate ratios among Canadians aged 20 years and older with and without ischemic heart disease (IHD), Canada*, 2000–2001 to 2012–2013



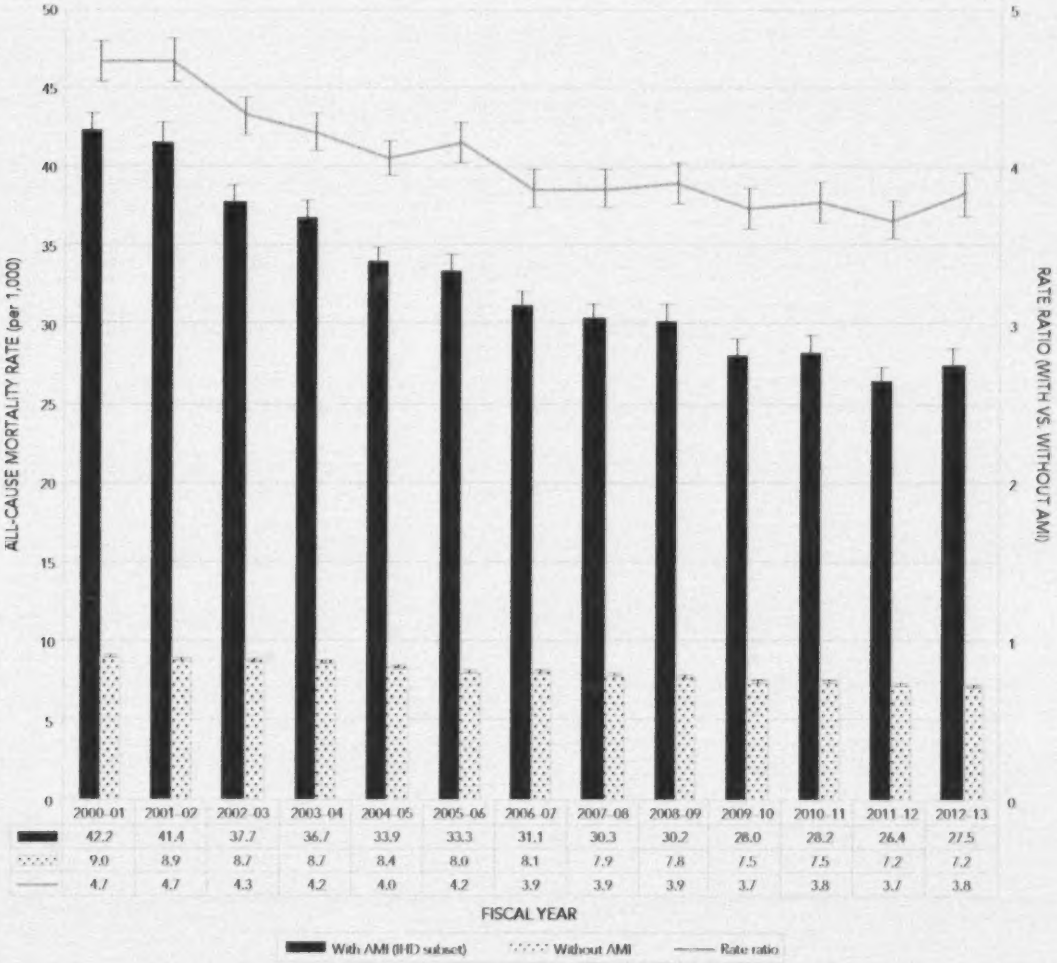
† Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 4B. Age-standardized[†] all-cause mortality rates and rate ratios among Canadians aged 20 years and older with and without acute myocardial infarction (AMI), Canada*, 2000–2001 to 2012–2013



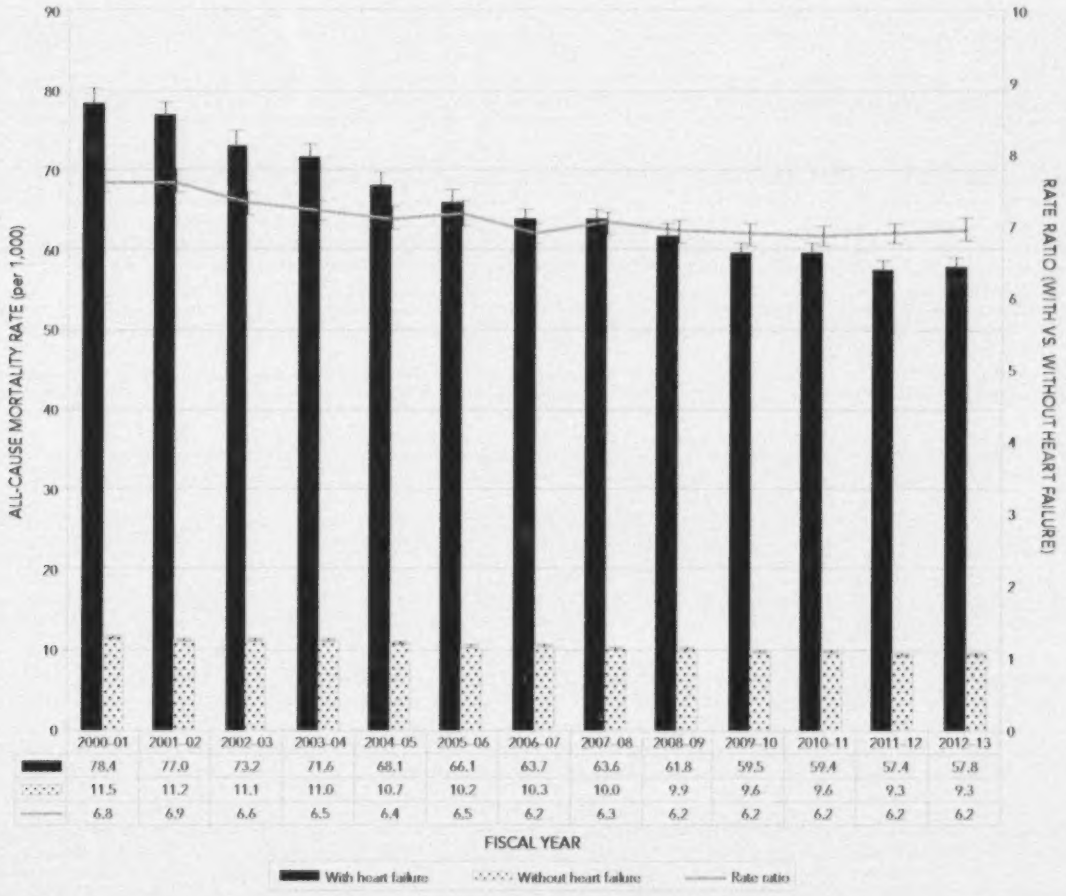
[†] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 4C. Age-standardized[†] all-cause mortality rates and rate ratios among Canadians aged 40 years and older with and without heart failure, Canada*, 2000–2001 to 2012–2013



	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
With heart failure	78.4	77.0	73.2	71.6	68.1	66.1	63.7	63.6	61.8	59.5	59.4	57.4	57.8
Without heart failure	11.5	11.2	11.1	11.0	10.7	10.2	10.3	10.0	9.9	9.6	9.6	9.3	9.3
Rate ratio	6.8	6.9	6.6	6.5	6.4	6.5	6.2	6.3	6.2	6.2	6.2	6.2	6.2

[†] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

MULTIPLE FACTORS EXPLAIN IMPROVED CARDIOVASCULAR HEALTH

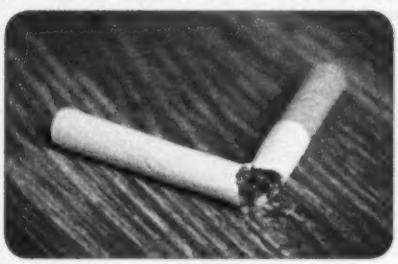
Between 2000–2001 and 2012–2013, age-standardized incidence (occurrence in the case of AMI) and all-cause mortality rates have declined greatly among those with IHD and heart failure and those having had an AMI.

Using a validated mortality model, Ford E. et al. quantified the respective contribution of major risk factors and medical treatments to the decline in mortality from coronary heart disease between 1980 and 2000, among American adults aged 25 to 84 years old. About 47% of this decline in mortality was attributed to treatments, including medications or rehabilitation, after an AMI. Approximately 44% of the decline was also attributed to changes in risk factors, namely decreases in total cholesterol, systolic blood pressure and smoking.[9] Similar studies conducted in Western countries found that trends in risk factors explained 44% to 76% of the decline whereas treatments explained 23% to 47%.[10]

Use of aspirin, antihypertensive medications and cholesterol-lowering medications (such as statins) reduce the risk of developing heart disease.[11,12] In addition, the effectiveness of cardiac drugs to relieve symptoms and prevent recurrent AMI and premature death has been well documented.[13-15] Improvements in cardiac care and use of surgical treatments, mainly coronary artery bypass surgery, has also been shown to reduce all-cause mortality rates and ischemic heart disease events.[16]

In the INTERHEART study, it was found that nine risk factors (smoking, high cholesterol, hypertension, diabetes, abdominal obesity, psychosocial factors, low consumption of fruits and vegetables, regular alcohol consumption and physical inactivity) accounted for 90% of the risk of developing AMI.[17] Together, smoking and high cholesterol alone accounted for two thirds of the risk worldwide.

In Canada, the proportion of people aged 15 years and older who self-reported smoking (daily or occasionally) decreased from 25.2% in 1999 to 13.0% in 2015.[18] However, based on directly measured data, the proportion of people aged 18 to 79 years who have elevated cholesterol remains high at 18.7%, with a greater proportion of men (29.8%) than women (7.8%) affected.[18]



The decline in the incidence of hypertension in Canada has likely contributed in part to the decline in IHD and heart failure incidence and all-cause mortality. For instance, from 2000–2001 to 2012–2013, age-standardized incidence rate of diagnosed hypertension decreased from 32.1 to 21.8 per 1,000.[19] Moreover, Canada has one of the highest proportions of hypertension control in the world, with about 68% of hypertensive adults being treated and controlled.[20]

On the other hand, the absolute number of people living with IHD and heart failure and those with a history of AMI increased, indicating better survival, mostly due to increased awareness of warning signs and risk factors for heart disease and improvements in risk factor reduction, disease management and treatment.[9,21]

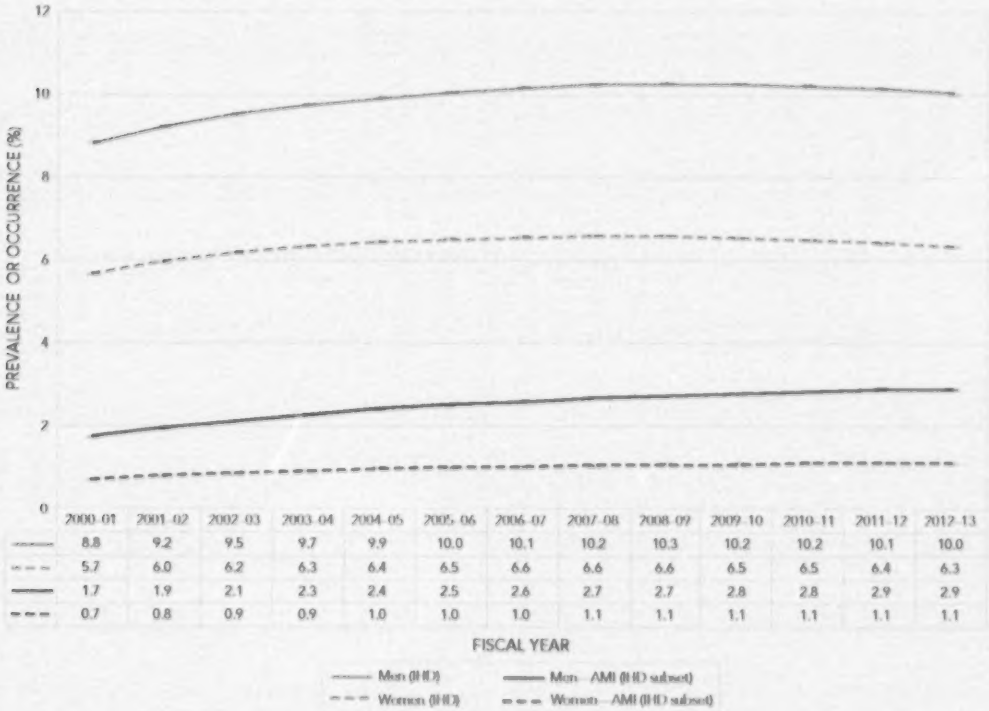
The absolute number of deaths increased in those with IHD and heart failure and those who had an AMI, a trend which may be due to population growth and aging. Similar patterns are observed in high-income regions throughout the world, with the increase in cardiovascular disease deaths being attributed to the aging of the population (55%) and population growth (25%).[22]

2.2 HEART DISEASE IN MEN AND WOMEN

2.2.1 Prevalence

- The age-standardized prevalence of IHD and heart failure and AMI occurrence were higher among men than women over the surveillance period (Figures 5A and 5B). This difference by sex was more pronounced for AMI, where the age-standardized occurrence was about 2.5 times higher among men than women, on average, from 2000–2001 to 2012–2013. This difference has slowly increased over time.
- IHD and heart failure prevalence as well as AMI occurrence increased with age for both women and men. The gap between the sexes narrows with age (Figures 6A and 6B).

FIGURE 5A. Prevalence (%[†] and number) of diagnosed ischemic heart disease (IHD) and occurrence (%[†] and number) of acute myocardial infarction (AMI) among Canadians aged 20 years and older, by sex, Canada*, 2000–2001 to 2012–2013



	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
——	8.8	9.2	9.5	9.7	9.9	10.0	10.1	10.2	10.3	10.2	10.2	10.1	10.0
- - -	5.7	6.0	6.2	6.3	6.4	6.5	6.6	6.6	6.6	6.5	6.5	6.4	6.3
——	1.7	1.9	2.1	2.3	2.4	2.5	2.6	2.7	2.7	2.8	2.8	2.9	2.9
- - -	0.7	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1

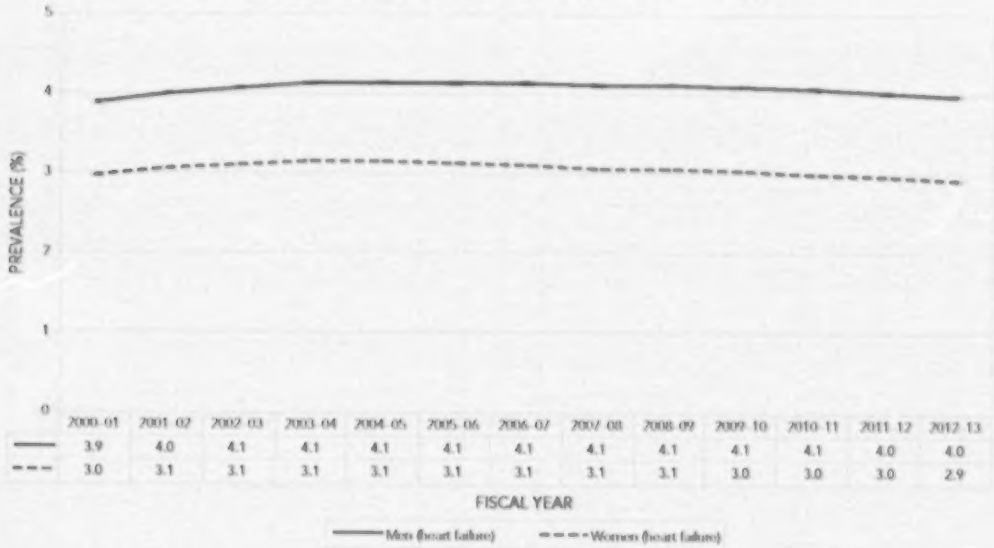
[†] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 5B. Age-standardized[†] prevalence of diagnosed heart failure among Canadians aged 40 years and older, by sex, Canada*, 2000–2001 to 2012–2013



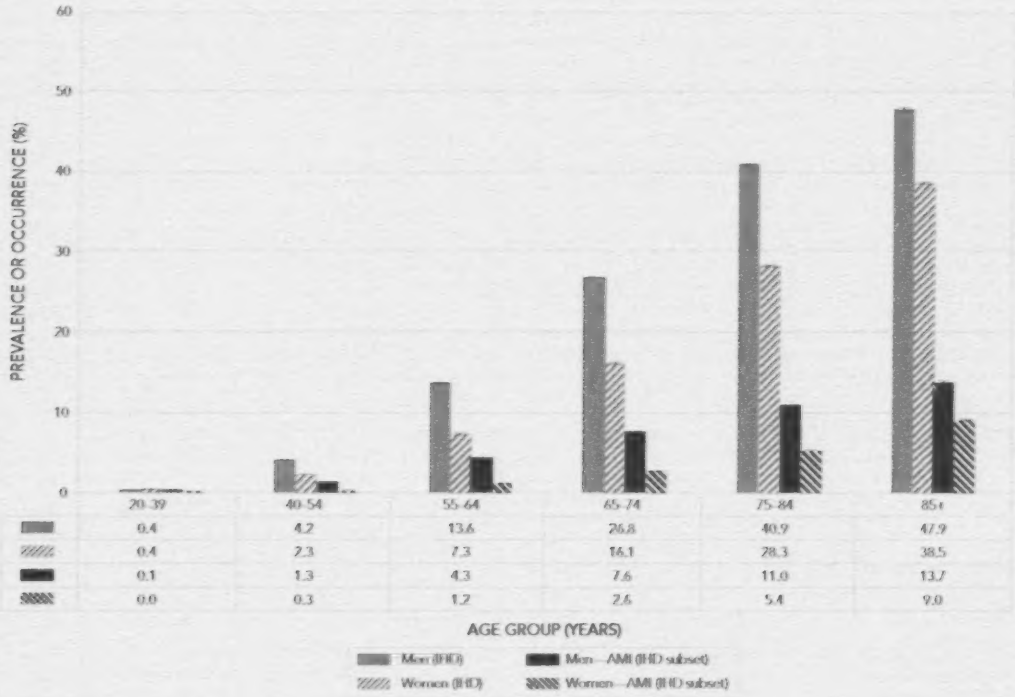
[†] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 6A. Prevalence of diagnosed ischemic heart disease (IHD) and occurrence of acute myocardial infarction (AMI) among Canadians aged 20 years and older, by age group and sex, Canada*, 2012–2013

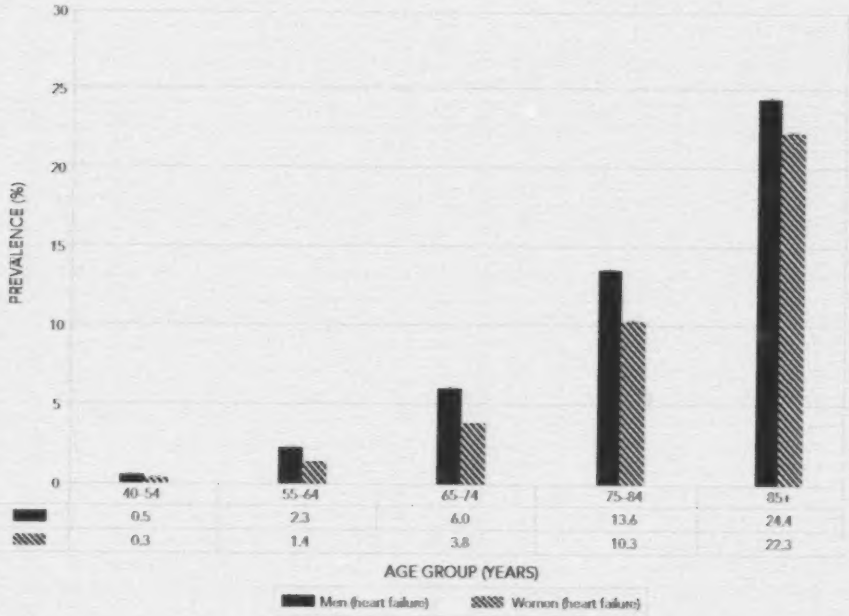


* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 6B. Prevalence of diagnosed heart failure among Canadians aged 40 years and older, by age group and sex, Canada*, 2012–2013



* Data from Yukon were not available.

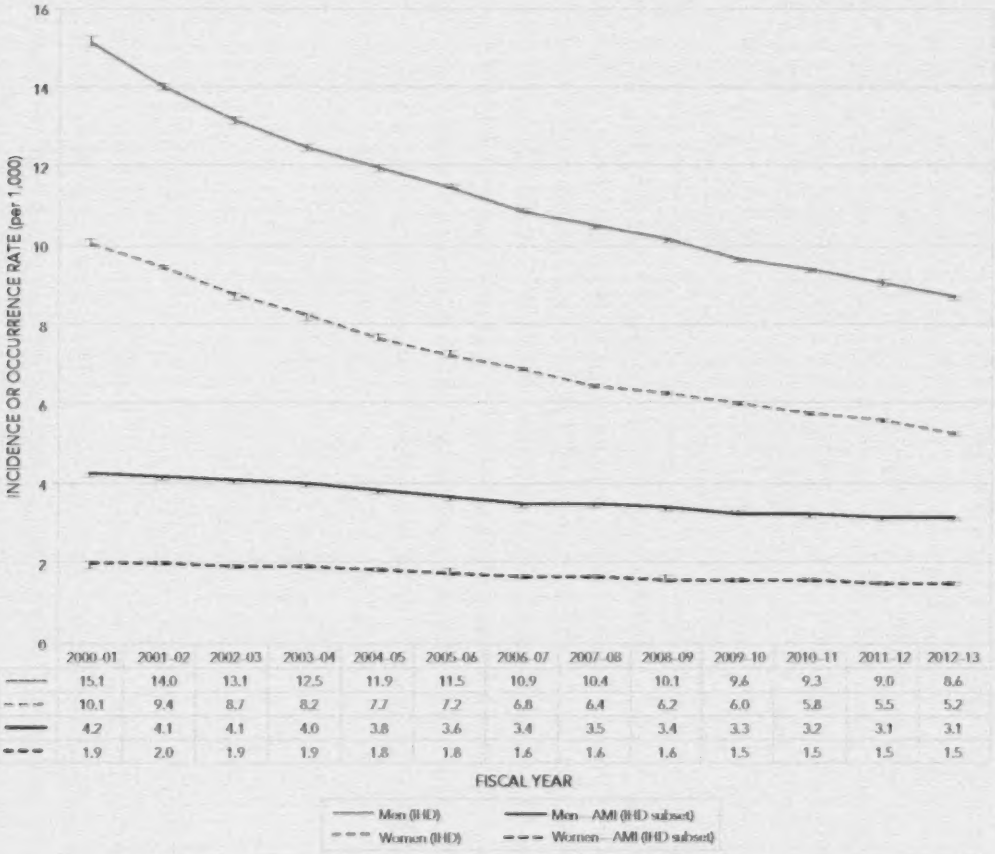
NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

2.2.2 Incidence (new cases)

- Age-standardized incidence rates of IHD and heart failure and occurrence rates of first AMI were higher among men than women across the 13-year period (Figures 7A and 7B). The difference by sex was more pronounced for AMI, with rates about 2.1 times higher, on average, among men than among women.
- IHD and heart failure incidence rates as well as occurrence rates of first AMI increased with age for both women and men (Figures 8A and 8B). Women tend to develop heart disease about 10 years later than men, but the gap between the sexes decreases as they get older.

FIGURE 7A. Incidence (rates†) of diagnosed ischemic heart disease (IHD) and occurrence (rates†) of first acute myocardial infarction (AMI) among Canadians aged 20 years and older, by sex, Canada*, 2000–2001 to 2012–2013



	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Men (IHD)	15.1	14.0	13.1	12.5	11.9	11.5	10.9	10.4	10.1	9.6	9.3	9.0	8.6
Women (IHD)	10.1	9.4	8.7	8.2	7.7	7.2	6.8	6.4	6.2	6.0	5.8	5.5	5.2
Men – AMI (IHD subset)	4.2	4.1	4.1	4.0	3.8	3.6	3.4	3.5	3.4	3.3	3.2	3.1	3.1
Women – AMI (IHD subset)	1.9	2.0	1.9	1.9	1.8	1.8	1.6	1.6	1.6	1.5	1.5	1.5	1.5

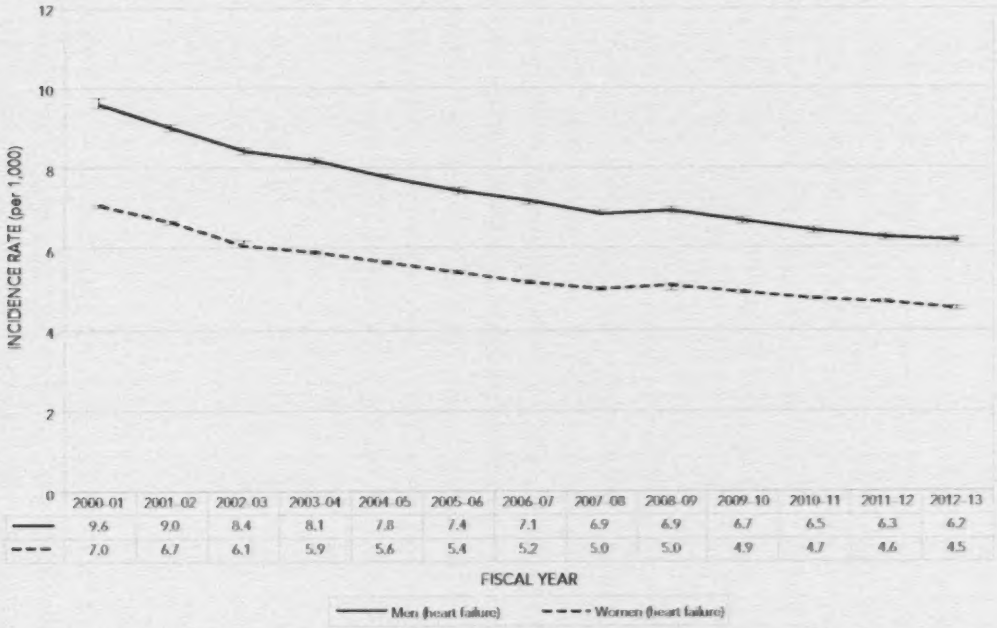
† Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 7B. Age-standardized[†] incidence rates of diagnosed heart failure among Canadians aged 40 years and older, by sex, Canada*, 2000–2001 to 2012–2013



	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
——	9.6	9.0	8.4	8.1	7.8	7.4	7.1	6.9	6.9	6.7	6.5	6.3	6.2
- - -	7.0	6.7	6.1	5.9	5.6	5.4	5.2	5.0	5.0	4.9	4.7	4.6	4.5

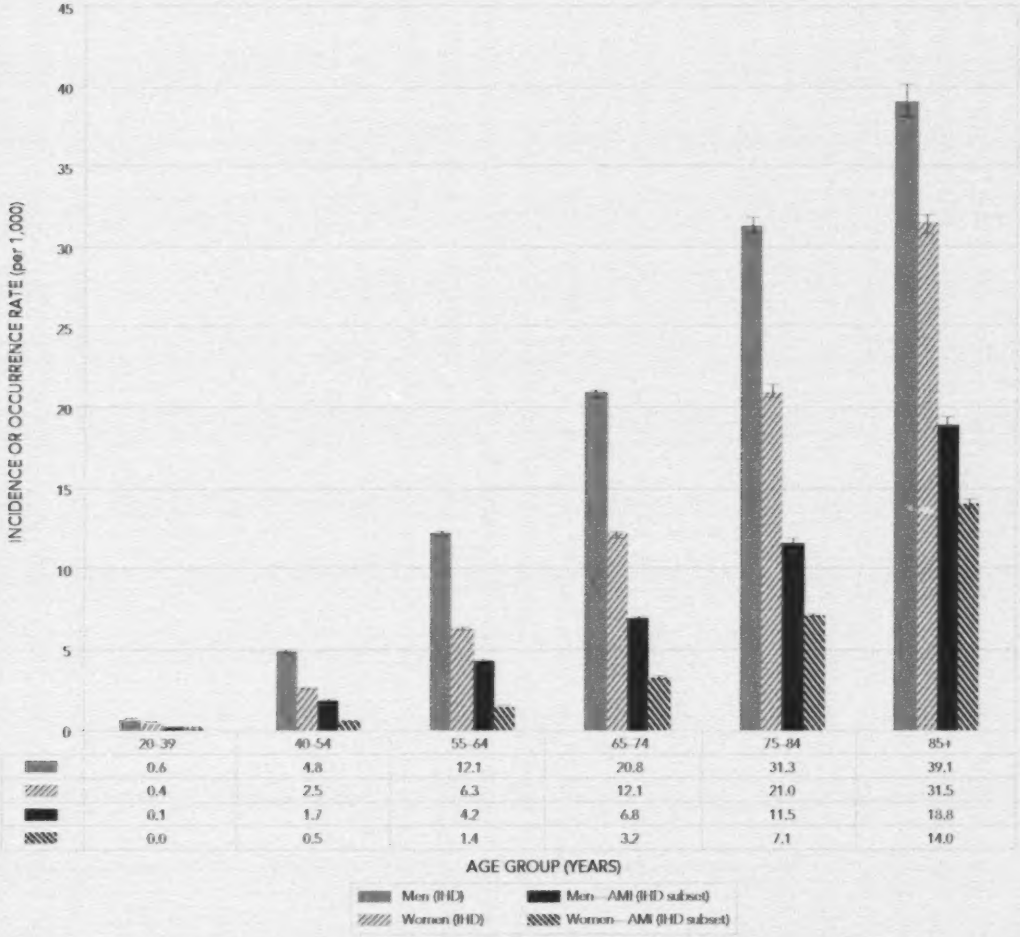
† Age-standardized to the 2011 Canadian population

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 8A. Incidence rates of diagnosed ischemic heart disease (IHD) and occurrence rates of first acute myocardial infarction (AMI) among Canadians aged 20 years and older, by age group and sex, Canada*, 2012–2013



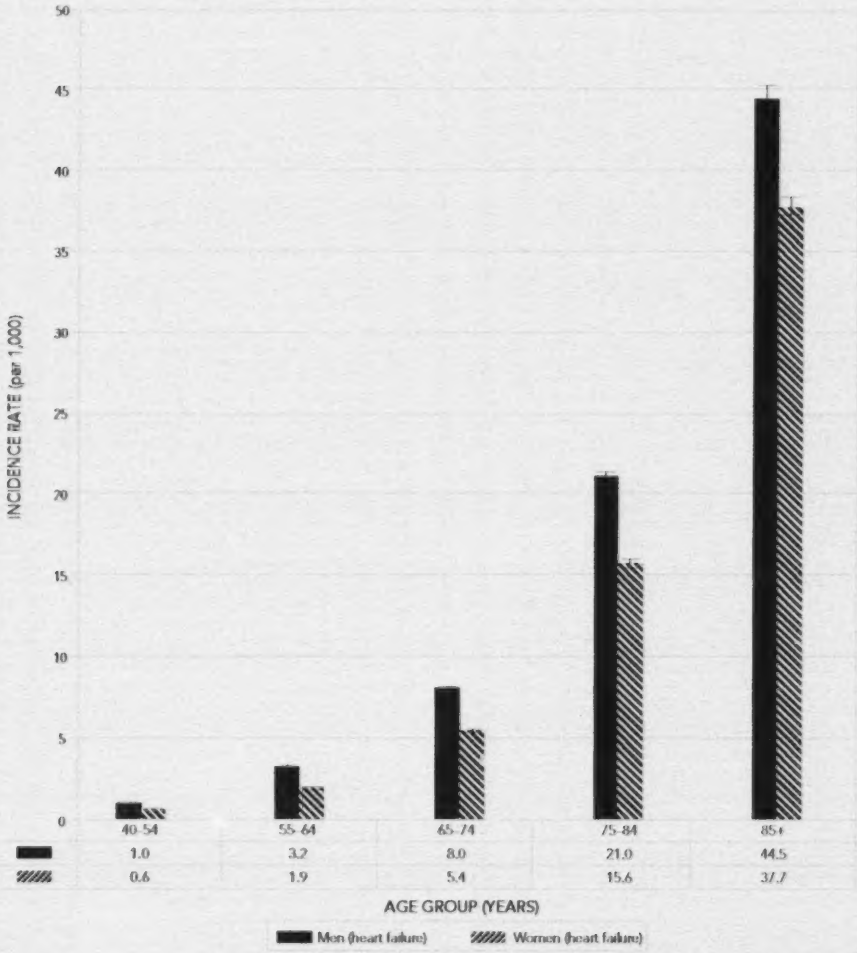
	20-39	40-54	55-64	65-74	75-84	85+
Men (IHD)	0.6	4.8	12.1	20.8	31.3	39.1
Women (IHD)	0.4	2.5	6.3	12.1	21.0	31.5
Men—AMI (IHD subset)	0.1	1.7	4.2	6.8	11.5	18.8
Women—AMI (IHD subset)	0.0	0.5	1.4	3.2	7.1	14.0

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 8B. Incidence rates of diagnosed heart failure among Canadians aged 40 years and older, by age group and sex, Canada*, 2012–2013



* Data from Yukon were not available.

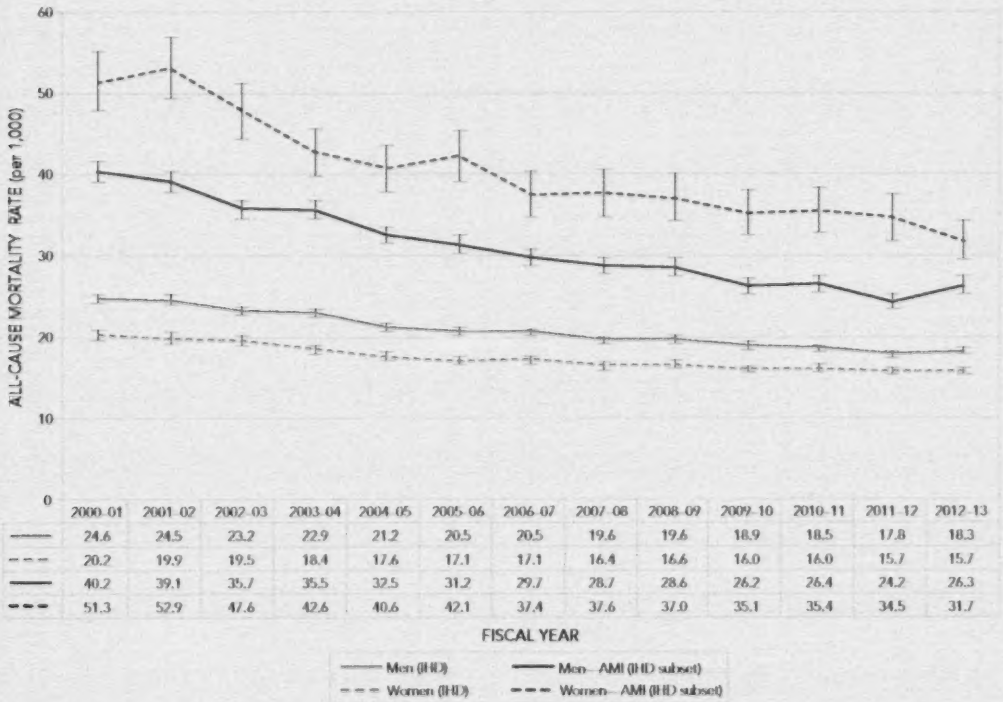
NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

2.2.3 All-Cause Mortality Rates

- Overall, age-standardized all-cause mortality rates among those with diagnosed IHD were slightly higher among men than women from 2000–2001 to 2012–2013 (Figure 9A). Relative declines of 22.3% and 25.9% were seen for women and men, respectively, over the 13–year period.
- For those with a prior history of AMI, all-cause mortality rates were higher in women than men in any given year. The age-standardized rate per 1,000 fell from 51.3 to 31.7 among women and from 40.2 to 26.3 among men between 2000–2001 and 2012–2013, with relative decreases of 38.2% and 34.7%, respectively (Figure 9A).
- As for heart failure, women and men had similar age-standardized all-cause mortality rates over time, as indicated by overlapping confidence intervals (Figure 9B). Rates fell for both women and men over time, with relative decreases of 24.2% and 28.2%, respectively.

FIGURE 9A. Age-standardized[†] all-cause mortality rates among Canadians aged 20 years and older with diagnosed ischemic heart disease (IHD) and acute myocardial infarction (AMI), by sex, Canada*, 2000–2001 to 2012–2013



	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
——	24.6	24.5	23.2	22.9	21.2	20.5	20.5	19.6	19.6	18.9	18.5	17.8	18.3
- - -	20.2	19.9	19.5	18.4	17.6	17.1	17.1	16.4	16.6	16.0	16.0	15.7	15.7
——	40.2	39.1	35.7	35.5	32.5	31.2	29.7	28.7	28.6	26.2	26.4	24.2	26.3
- - -	51.3	52.9	47.6	42.6	40.6	42.1	37.4	37.6	37.0	35.1	35.4	34.5	31.7

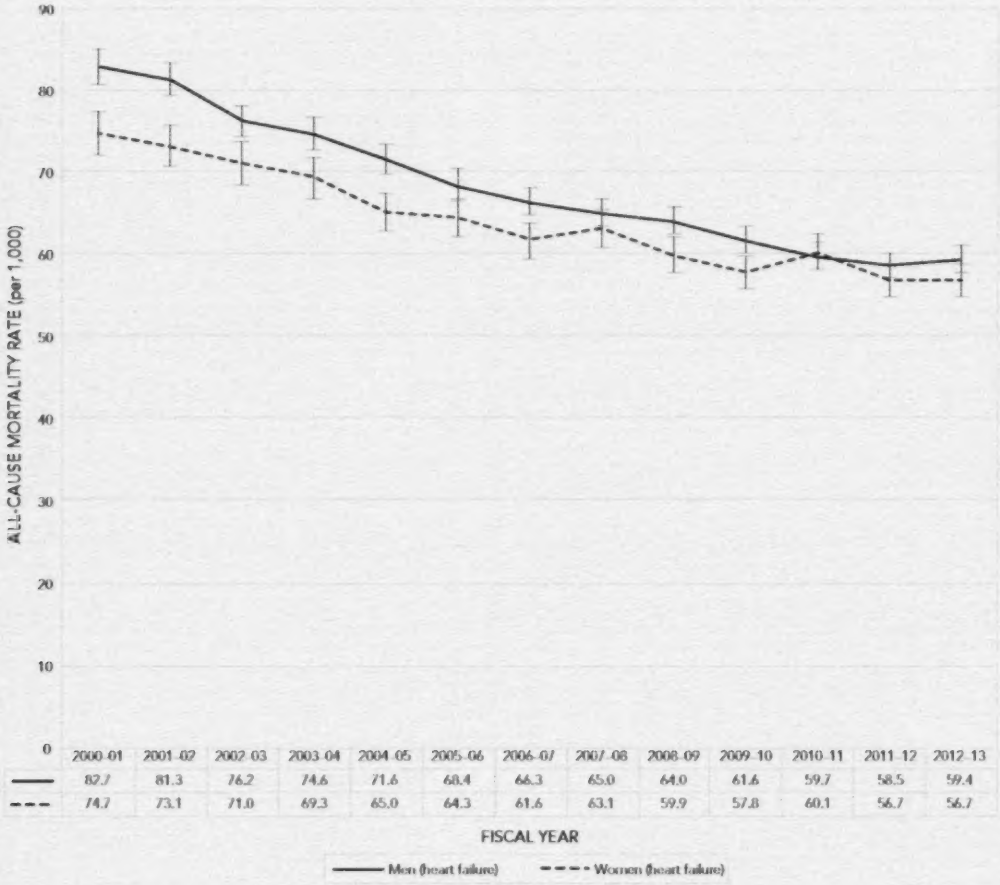
[†] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 9B. Age-standardized[†] all-cause mortality rates among Canadians aged 40 years and older with diagnosed heart failure, by sex, Canada*, 2000–2001 to 2012–2013



[†] Age-standardized to the 2011 Canadian population.

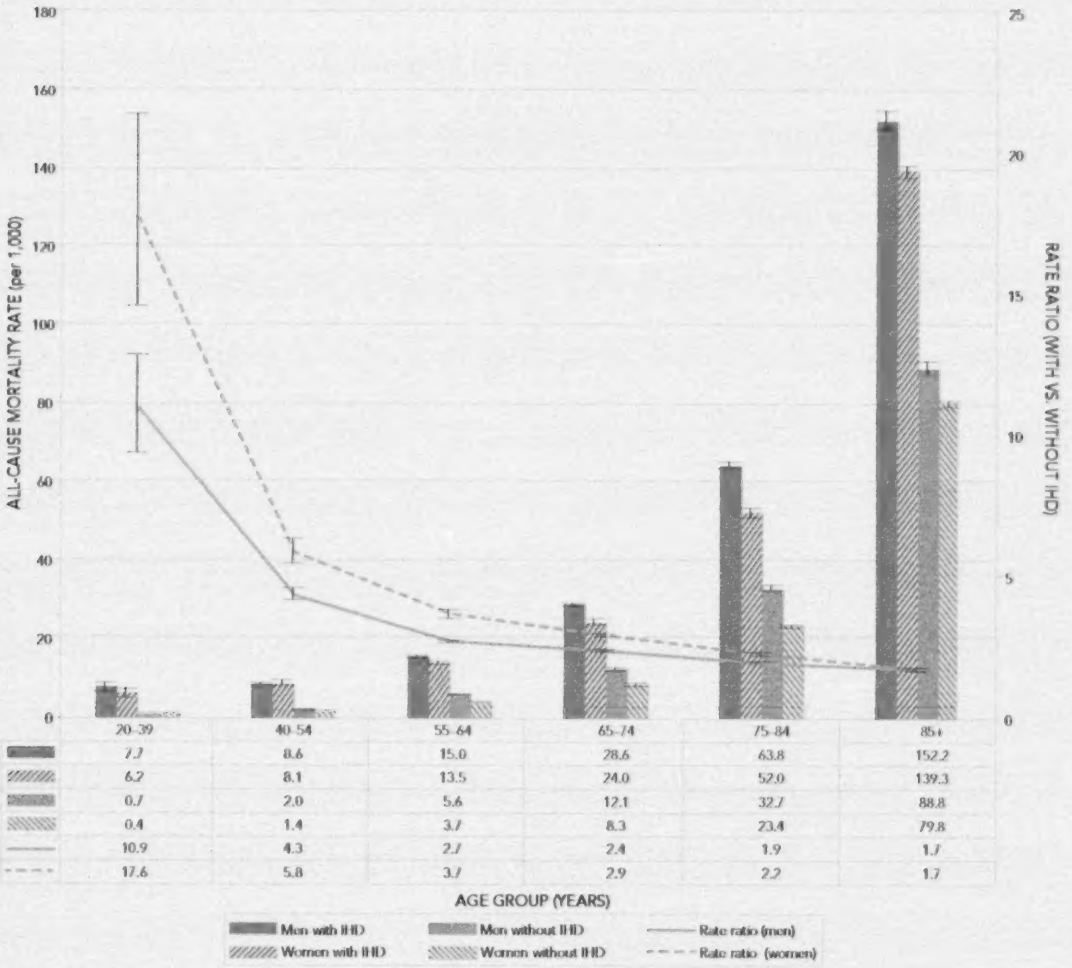
* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

- Overall in 2012–2013, men with diagnosed IHD were, on average, 1.2 times more likely to die of any cause than women with diagnosed IHD (Figure 10A) during the year. Younger women and men, aged 20 to 39 years, with diagnosed IHD were about 17.6 and 10.9 times more likely to die, respectively, than those without the disease (Figure 10A). As age increased, mortality rate ratios decreased considerably; it was down to 1.7 for both women and men aged 85 years and older.
- Overall, in 2012–2013, women with a prior AMI were, on average, 1.3 times more likely to die of any cause compared with men who had a prior AMI. Higher mortality rates observed among women aged 45 to 74 years old drive this difference (Figure 10B).
- In 2012–2013, women aged 20 to 44 years with a prior AMI were about 27.6 times more likely to die of any cause compared to those without. This result should be interpreted with caution however since the confidence interval is wide in this age group. Men of the same age with a prior AMI were about 15.6 times more likely to die of any cause than men without in 2012–2013. As age increased, mortality rate ratios decreased to the point that both women and men had similar rate ratios (Figure 10B).
- In 2011–2012, all-cause mortality rates 365 days following a hospitalization with a recorded history of AMI were higher in women than in men aged 20 to 74 years old. Rates ranged respectively from 60.0 to 194.7 per 1,000 and from 20.9 to 175.0 per 1,000. Starting at age 75, men had higher rates than women (Figure 10C).
- Starting at age 65, all-cause mortality rates were higher among men with diagnosed heart failure than among women of the same age with the disease in 2012–2013 (Figure 10D).
- In 2012–2013, women and men aged 40 to 54 years old with diagnosed heart failure were 27.3 and 16.5 times more likely to die of any cause during the year, respectively, than those without the disease. As age increased, mortality rate ratios decreased down to 2.6 for both women and men aged 85 years and older (Figure 10D).

FIGURE 10A. All-cause mortality rates and rate ratios among Canadians aged 20 years and older with diagnosed ischemic heart disease (IHD) compared to those without, by age group and sex, Canada*, 2012–2013



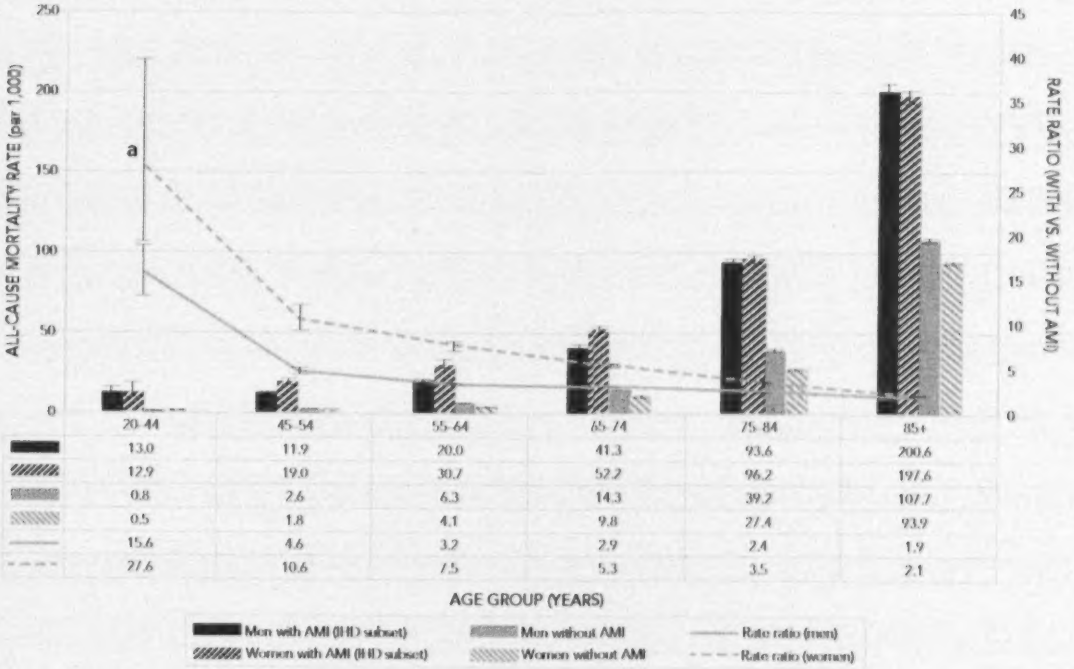
	20–39	40–54	55–64	65–74	75–84	85+
Men with IHD	7.7	8.6	15.0	28.6	63.8	152.2
Women with IHD	6.2	8.1	13.5	24.0	52.0	139.3
Men without IHD	0.7	2.0	5.6	12.1	32.7	88.8
Women without IHD	0.4	1.4	3.7	8.3	23.4	79.8
Rate ratio (men)	10.9	4.3	2.7	2.4	1.9	1.7
Rate ratio (women)	17.6	5.8	3.7	2.9	2.2	1.7

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 10B. All-cause mortality rates and rate ratios among Canadians aged 20 years and older who had an acute myocardial infarction (AMI) compared to those without, by age group and sex, Canada*, 2012–2013



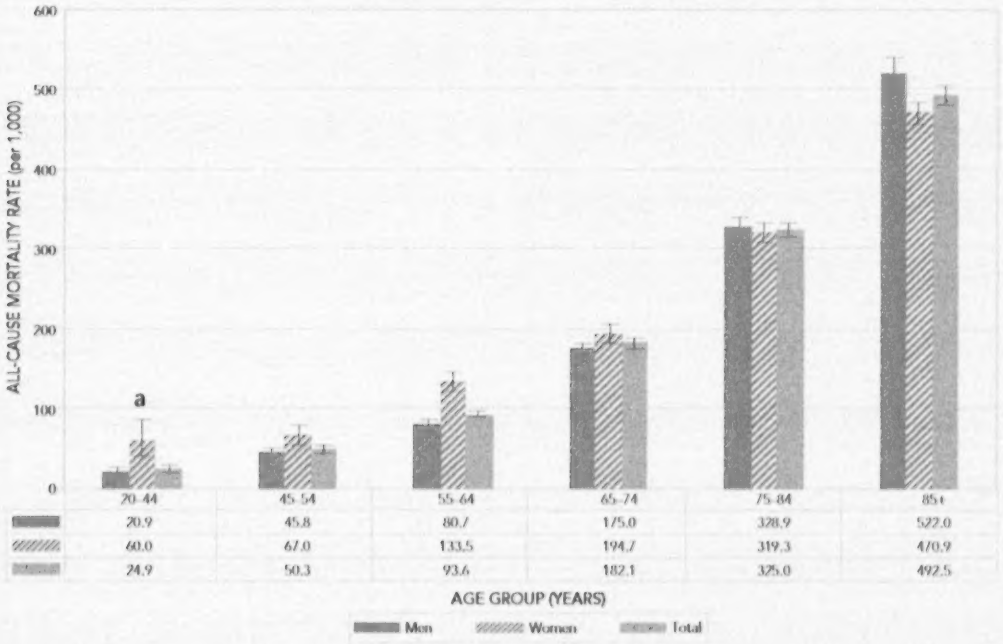
* Data from Yukon were not available.

a Interpret with caution, coefficient of variation between 16.6% and 33.3%.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 10C. All-cause mortality rates within 365 days of a hospital admission with a recorded history of acute myocardial infarction (AMI), among Canadians aged 20 years and older, by age group and sex, Canada*, 2011–2012



	20-44	45-54	55-64	65-74	75-84	85+
Men	20.9	45.8	80.7	175.0	328.9	522.0
Women	60.0	67.0	133.5	194.7	319.3	470.9
Total	24.9	50.3	93.6	182.1	325.0	492.5

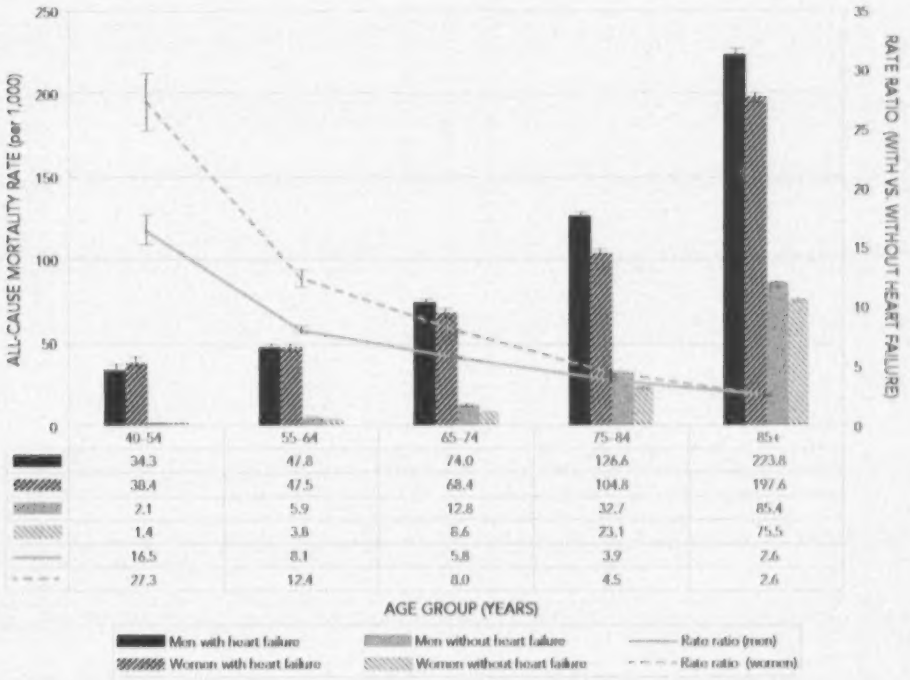
* Data from Yukon were not available.

a Interpret with caution, coefficient of variation between 16.6% and 33.3%.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 10D. All-cause mortality rates and rate ratios among Canadians aged 40 years and older with diagnosed heart failure compared to those without, by age group and sex, Canada*, 2012–2013



	40-54	55-64	65-74	75-84	85+
Men with heart failure	34.3	47.8	74.0	126.6	223.8
Women with heart failure	38.4	47.5	68.4	104.8	197.6
Men without heart failure	2.1	5.9	12.8	32.7	85.4
Women without heart failure	1.4	3.8	8.6	23.1	75.5
Rate ratio (men)	16.5	8.1	5.8	3.9	2.6
Rate ratio (women)	27.3	12.4	8.0	4.5	2.6

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FACTORS CONTRIBUTING TO THE SEX DIFFERENCES IN HEART DISEASE

As shown in Figure 8A, women have incident heart disease about ten years later than men. Such a lag has been documented in the Framingham Heart Study.[23,24] Evidence indicates that sex hormones, namely estrogens, provide a cardioprotective effect to women before menopause[25-28] which may explain the lower incidence rates observed in younger women compared to men or postmenopausal women of the same age. This protective effect disappears shortly after menopause,[24] at which time drop in sex hormones occurs and the risk of coronary heart disease rises sharply.

The mechanism explaining this protective effect has yet to be fully understood. The burden of risk factors that women carry after menopause, such as a rise in cholesterol levels and a high prevalence of hypertension and diabetes, has been shown to make women more vulnerable to heart disease.[24]

Moreover, heart conditions may be more difficult to diagnose in women because they sometimes have fewer typical symptoms compared with men, which may contribute to the sex-specific gap. Although chest pain is the most common symptom of AMI in both sexes, women are more likely than men to present to the hospital without chest pain or with mild chest pain. As a result, women are more likely to be misdiagnosed.[29,30] Longer delays in seeking medical care have also been documented in women and may contribute to poorer outcomes for women than men, such as higher in-hospital mortality.[29] Complications such as major bleeding during hospitalization have also been studied and women, especially younger women, were at greater risk than men of having such complications.[31]

These factors likely also contribute to the higher all-cause mortality rates observed in women younger than 75 years old compared with men of the same age who had a prior AMI, as shown in Figure 10B and 10C above. Studies have found similar results, with younger women having higher mortality than men after a myocardial infarction.[32-34] Even after adjusting for comorbidities and cardiovascular risk factors, Champney et al. found that women aged less than 70 years old still had a greater risk of death (approximately 20%) compared to men in the same age group.[33]

In the CCDSS, this difference in all-cause mortality among women and men with IHD (or those who had an AMI) disappeared after the age of 75 years. In fact, elderly men have higher all-cause mortality rates than women of the same age. Women's longer life expectancy[35] and greater use of health services in general in older age, including visiting a general practitioner, may contribute to the pattern observed.[36]

With men being more likely than women to be newly diagnosed with IHD and heart failure, it is important to continue to raise awareness of the heart disease burden in men. Better detection of heart disease in women of all ages is also of high importance because of the high fatality rate associated with their first AMI[21] and poorer outcomes and risk of complications in general.

HEART DISEASE DIFFERENCES BETWEEN MEN AND WOMEN

Men ♂

Heart disease is more common among men than among women, with men being as much as 2.5X more likely than women to have had a heart attack.

11X

In a given year, young men (aged 20 to 39) with IHD are 11X more likely to die of any cause than young men without IHD.

16X

In a given year, men between the ages of 40 and 54 with heart failure are 16X more likely to die of any cause than men of the same age without heart failure.

Women ♀

On average, women develop heart disease about 10 years later than men.

18X

In a given year, young women (aged 20 to 39) with IHD are 18X more likely to die of any cause than young women without IHD.

27X

In a given year, women between the ages of 40 and 54 with heart failure are 27X more likely to die of any cause than women of the same age without heart failure.

2.3 PAN-CANADIAN PERSPECTIVE

Across Canada, estimates vary widely by province/territory and by condition. Unless otherwise specified, all differences from the national average presented herein are statistically significant.

2.3.1 Prevalence

- In 2012–2013, age-standardized ischemic heart disease (IHD) prevalence ranged from a low of 4.6% in Nunavut to a high of 9.7% in Nova Scotia (Figure 11).
- Age-standardized acute myocardial infarction (AMI) occurrence ranged from a low of 1.1% in Nunavut to a high of 2.6% in Newfoundland and Labrador (Figure 12).
- Age-standardized heart failure prevalence ranged from a low of 3.2% in Quebec, New Brunswick and Nova Scotia to a high of 6.4% in Nunavut (Figure 13).

FIGURE 11. Age-standardized[†] prevalence of diagnosed ischemic heart disease, among Canadians aged 20 years and older, by province or territory*, 2012–2013

	PREVALENCE (%)	95% CONFIDENCE INTERVAL
Canada	8.1	8.1-8.1
Yukon	N/A	N/A
Northwest Territories	6.8	6.5-7.3
Nunavut	4.6	4.1-5.2
British Columbia	6.6	6.6-6.6
Alberta	7.3	7.3-7.3
Saskatchewan	7.8	7.8-7.9
Manitoba	6.6	6.6-6.7
Ontario	8.5	8.5-8.5
Quebec	8.4	8.4-8.5
New Brunswick	9.4	9.3-9.4
Nova Scotia	9.7	9.7-9.8
Prince Edward Island	6.9	6.8-7.0
Newfoundland and Labrador	8.0	8.0-8.1

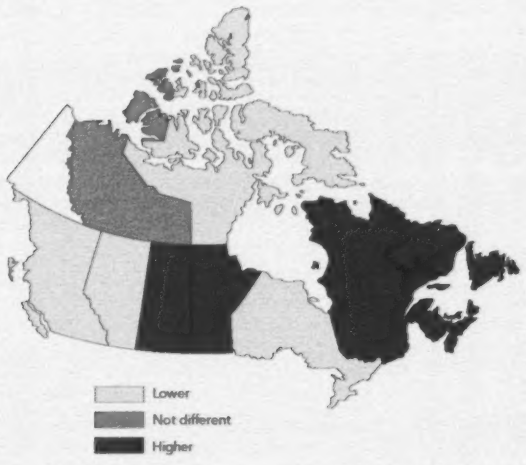
[†] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 12. Age-standardized[†] occurrence of acute myocardial infarction, among Canadians aged 20 years and older, by province or territory*, 2012–2013



	OCCURRENCE (%)	95% CONFIDENCE INTERVAL
Canada	2.0	2.0-2.0
Yukon	N/A	N/A
Northwest Territories	1.8	1.6-2.0
Nunavut	1.1	0.9-1.4
British Columbia	1.6	1.6-1.6
Alberta	1.8	1.8-1.9
Saskatchewan	2.0	2.0-2.1
Manitoba	2.1	2.1-2.1
Ontario	1.9	1.9-1.9
Quebec	2.1	2.1-2.1
New Brunswick	2.5	2.5-2.5
Nova Scotia	2.4	2.3-2.4
Prince Edward Island	2.3	2.2-2.4
Newfoundland and Labrador	2.6	2.5-2.6

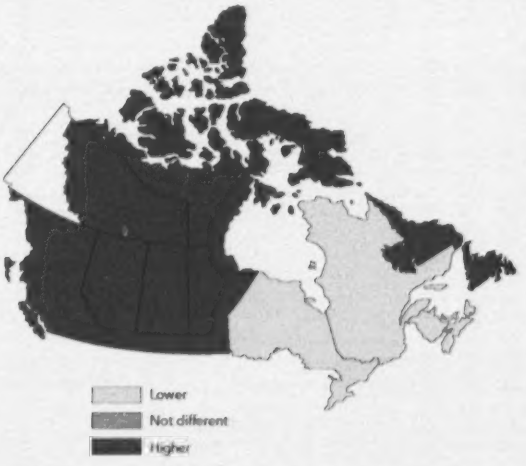
[†] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 13. Age-standardized[†] prevalence of diagnosed heart failure, among Canadians aged 40 years and older, by province or territory*, 2012–2013



	PREVALENCE (%)	95% CONFIDENCE INTERVAL
Canada	3.4	3.4-3.4
Yukon	N/A	N/A
Northwest Territories	4.1	3.7-4.6
Nunavut	6.4	5.6-7.3
British Columbia	3.5	3.5-3.6
Alberta	3.8	3.7-3.8
Saskatchewan	4.1	4.1-4.2
Manitoba	3.8	3.8-3.9
Ontario	3.3	3.3-3.3
Quebec	3.2	3.2-3.2
New Brunswick	3.2	3.2-3.3
Nova Scotia	3.2	3.1-3.2
Prince Edward Island	3.3	3.2-3.4
Newfoundland and Labrador	4.7	4.7-4.8

[†] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

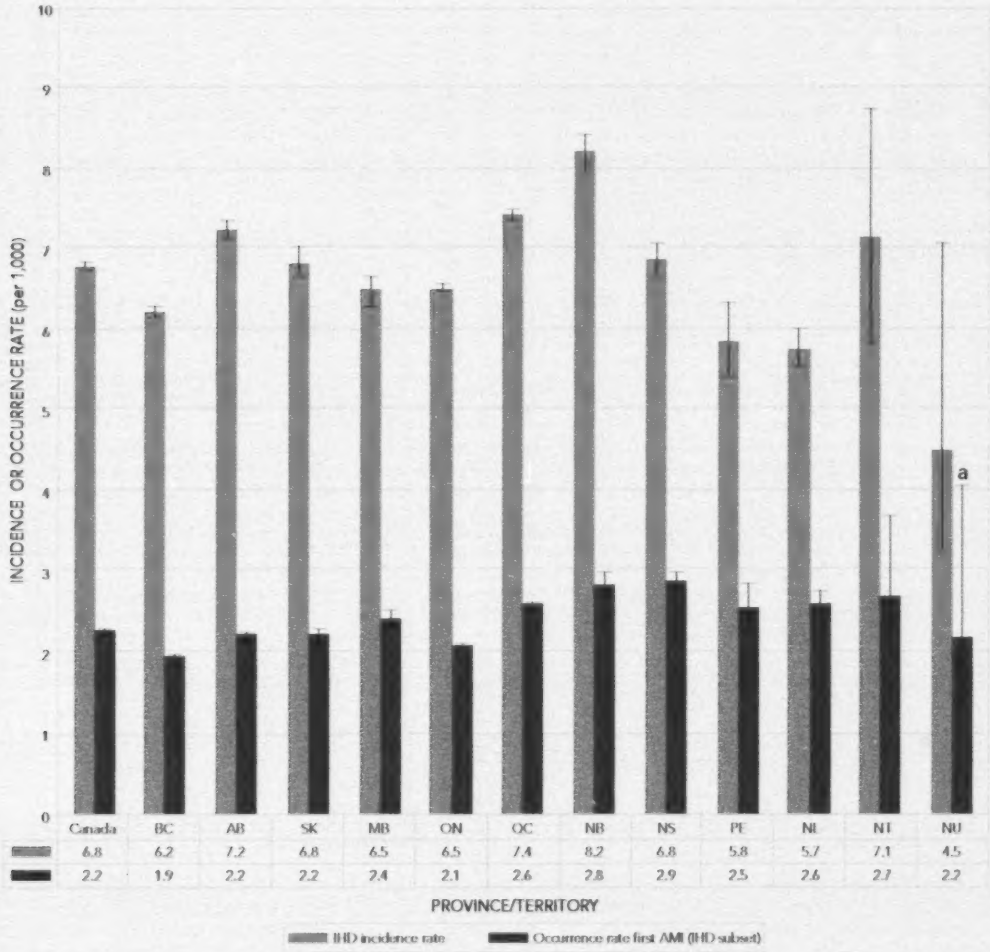
NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

2.3.2 Incidence (new cases)

- In 2012–2013, age-standardized IHD incidence rates ranged from a low of 4.5 per 1,000 in Nunavut to a high of 8.2 per 1,000 in New Brunswick (Figure 14). Rates in New Brunswick, Quebec and Alberta were higher than the national average.
- As for AMI, age-standardized rates ranged from 1.9 per 1,000 in British Columbia to 2.9 per 1,000 in Nova Scotia (Figure 14).
- Age-standardized heart failure incidence rates ranged from 4.8 per 1,000 in Nova Scotia and Newfoundland and Labrador to 11.3 per 1,000 in Nunavut, but the latter should be interpreted with caution due to variability in the rates. Heart failure incidence rates were higher in British Columbia, Alberta, Saskatchewan and Manitoba while rates in Ontario, Quebec and Nova Scotia were lower than the Canadian average (Figure 15). Rates in the other provinces and territories were not statistically different than Canada as a whole.

FIGURE 14. Incidence (rate†) of diagnosed ischemic heart disease and occurrence (rate†) of first acute myocardial infarction (AMI), among Canadians aged 20 years and older, by province or territory*, 2012–2013



† Age-standardized to the 2011 Canadian population.

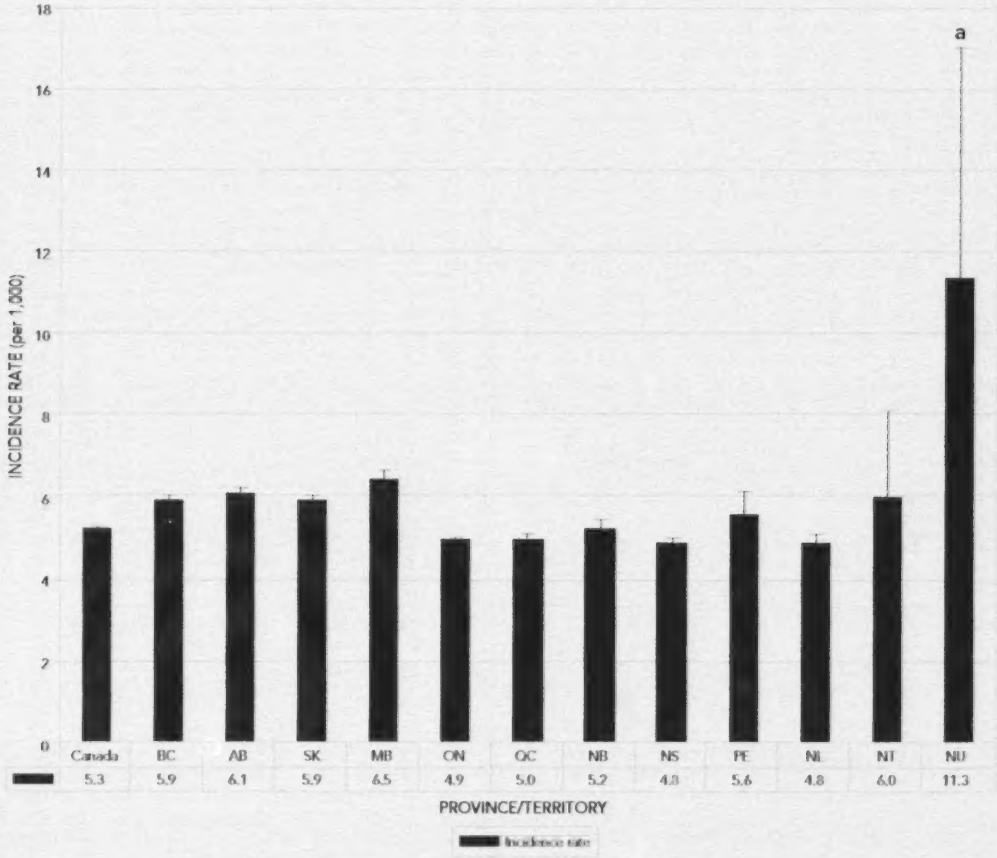
* Data from Yukon were not available.

a Interpret with caution, coefficient of variation between 16.6% and 33.3%.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20. BC: British Columbia, AB: Alberta, SK: Saskatchewan, MB: Manitoba, ON: Ontario, QC: Quebec, NB: New Brunswick, NS: Nova Scotia, PE: Prince Edward Island, NL: Newfoundland and Labrador, NT: Northwest Territories, NU: Nunavut.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 15. Age-standardized[1] incidence of diagnosed heart failure, among Canadians aged 40 years and older, by province or territory*, 2012–2013



[1] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

a Interpret with caution, coefficient of variation between 16.6% and 33.3%.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20. BC: British Columbia, AB: Alberta, SK: Saskatchewan, MB: Manitoba, ON: Ontario, QC: Quebec, NB: New Brunswick, NS: Nova Scotia, PE: Prince Edward Island, NL: Newfoundland and Labrador, NT: Northwest Territories, NU: Nunavut.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

The differences observed for IHD and AMI across provinces and territories may relate to differences in the distribution of risk factors known to contribute to the development of heart disease such as smoking, low level of physical activity, alcohol abuse, low consumption of fruits and vegetables, obesity, diabetes and hypertension. These risk factors have been documented to be high in the Atlantic provinces.[6] However, differences in detection and treatment practices, as well as differences in data coding, remuneration models and shadow billing practices also likely play a role in the patterns observed. Even though differences are statistically significant, methodological differences may explain the patterns observed in addition to actual differences in the health status of the populations.

Heart failure estimates were higher in British Columbia, Alberta, Saskatchewan and Manitoba and lower in Quebec, New Brunswick and Nova Scotia, a pattern that is not consistent with that observed for IHD and AMI. This may relate to differences in billing methods and clinical practices as highlighted previously and warrants further investigation.

3. ISCHEMIC HEART DISEASE AND HEART FAILURE RELATIONSHIP

3.1 HEART DISEASE RISK FACTORS AND TREATMENTS

The underlying mechanism of ischemic heart disease (IHD) is atherosclerosis, which refers to the build-up of plaque (fat and other materials) on the inner walls of coronary arteries. Atherosclerosis can lead to blockages of the coronary arteries and restrict the flow of blood to the heart muscle.

Risk factors for IHD include high cholesterol, smoking, high blood pressure (hypertension), diabetes, abdominal obesity, and lack of regular physical activity.[17] Unhealthy diet and excessive alcohol consumption have also been shown to increase the risk of IHD.[17] Treatment options for IHD include lifestyle management, medications, and procedures such as percutaneous coronary intervention or coronary artery bypass graft surgery.

IHD can lead to acute myocardial infarction (AMI) which refers to deprivation of blood supply to a part of the heart muscle for a long enough period of time to cause tissue death. The most common reason for an AMI is thrombus formation (blood clot) in vessels with plaque. Typical symptoms of an AMI may include chest pain, often radiating to the left arm and left side of the neck, shortness of breath, sweating, and palpitations.

Left untreated, IHD may lead to heart failure over time. Heart failure is a clinical syndrome and refers to the inability of the heart to pump an adequate volume of blood throughout the body. In other words, the heart is not pumping as well as it should. The most common cause of heart failure is damage to the heart muscle as a result of heart disease.[37] Other factors may also increase the risk of heart failure including, but not limited to, higher body mass index, abdominal fat accumulation, elevated blood cholesterol, elevated fasting blood glucose, elevated systolic blood pressure, cigarette smoking, and valvular heart disease.[37,38] Symptoms of heart failure may include shortness of breath, swelling of the legs, and a low energy level.[38] The management of heart failure includes medications, restriction of fluid intake, and a low salt diet.[38]

3.2 ISCHEMIC HEART DISEASE AND HEART FAILURE COMORBIDITY

Examining the comorbidity of IHD and heart failure in the Canadian Chronic Disease Surveillance System in 2012–2013 overall, it was found that among those with diagnosed heart failure, about 71.0% of individuals aged 40 years and older also had IHD compared to only about 10.5% in those without heart failure. The age-specific prevalence of IHD among those with and without heart failure is shown in Figure 16. The prevalence of IHD among those with and without heart failure increased with age, but the difference between the two groups declined with age.

Over time, the age-standardized prevalence ratio of IHD among those with and without heart failure decreased from 6.9 in 2000–2001 to 5.7 in 2012–2013 (Figure 17). A similar decline is seen for both women and men. This trend suggests that the difference in IHD prevalence between those with and without heart failure is getting smaller over time.

Overall, in 2012–2013, among those aged 40 years and older with diagnosed IHD, about 20.3% also had heart failure compared to only 1.2% in those aged 40 years and older without IHD. The age-specific prevalence of heart failure among those with and without IHD is shown in Figure 18. The prevalence of heart failure among those with and without IHD increased with age and the difference between the two groups declined with age.

The age-standardized prevalence ratio of heart failure among those with and without IHD decreased over time from 9.3 in 2000–2001 to 8.8 in 2012–2013. The prevalence ratio remained constant in men over the observation period, but declined from 9.2 to 8.2 in women (Figure 19).

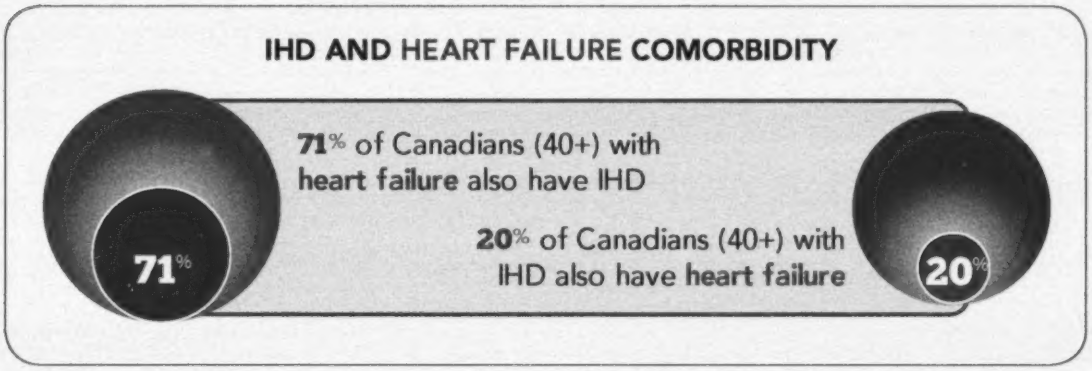
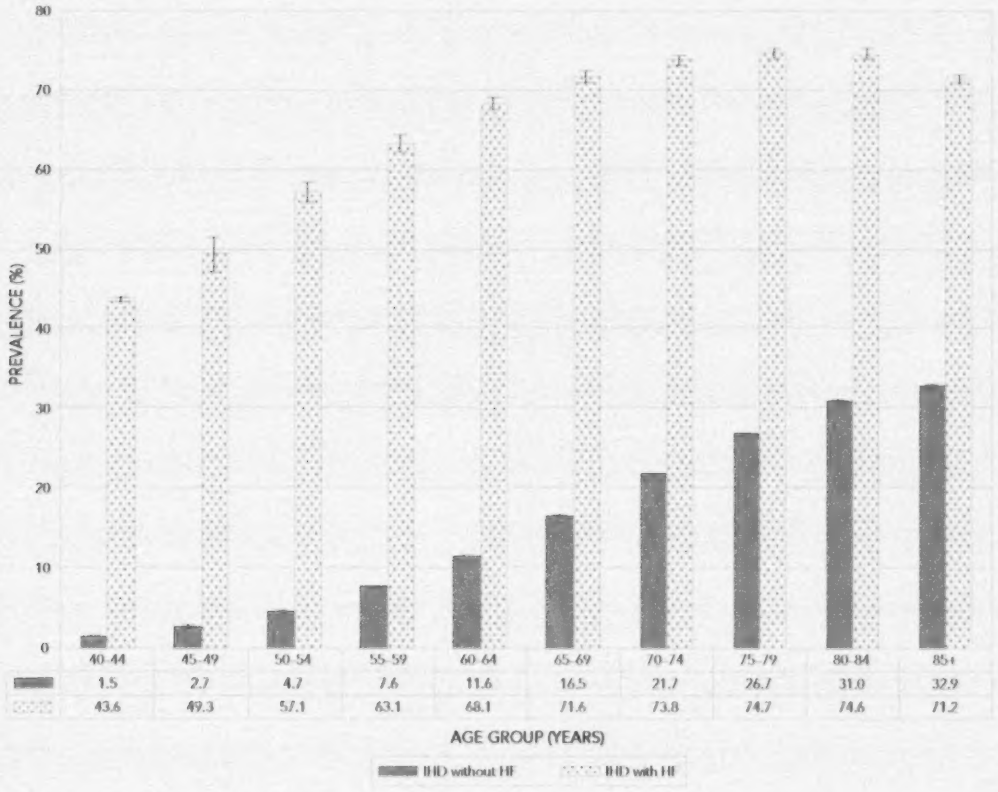

IHD AND HEART FAILURE COMORBIDITY
71% of Canadians (40+) with heart failure also have IHD
71%
20% of Canadians (40+) with IHD also have heart failure
20%

FIGURE 16. Prevalence of diagnosed ischemic heart disease (IHD) among Canadians aged 40 years and older with and without diagnosed heart failure (HF), by age group, Canada*, 2012–2013

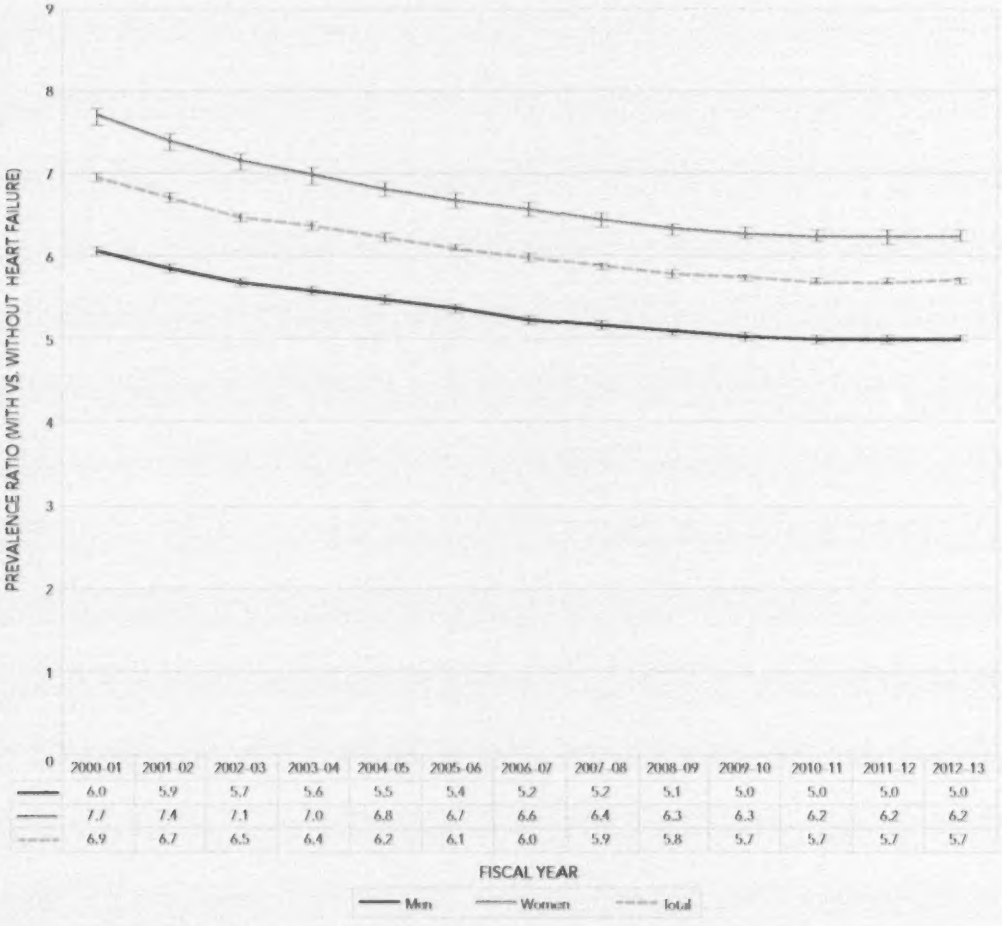


* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 17. Age-standardized[†] prevalence ratio of diagnosed ischemic heart disease among Canadians aged 40 years and older with and without diagnosed heart failure, Canada*, 2000–2001 to 2012–2013



	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Men	6.0	5.9	5.7	5.6	5.5	5.4	5.2	5.2	5.1	5.0	5.0	5.0	5.0
Women	7.7	7.4	7.1	7.0	6.8	6.7	6.6	6.4	6.3	6.3	6.2	6.2	6.2
Total	6.9	6.7	6.5	6.4	6.2	6.1	6.0	5.9	5.8	5.7	5.7	5.7	5.7

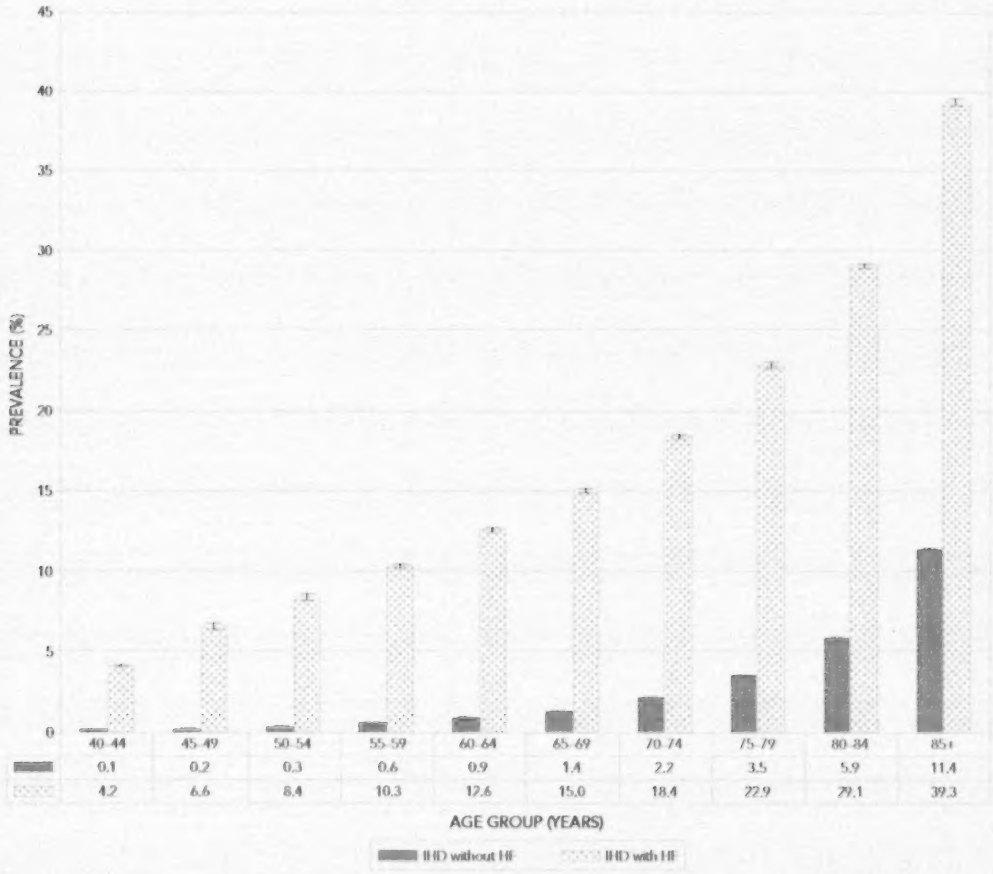
[†] Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 18. Prevalence of diagnosed heart failure (HF) among Canadians aged 40 years and older with and without diagnosed ischemic heart disease (IHD), by age group, Canada*, 2012–2013

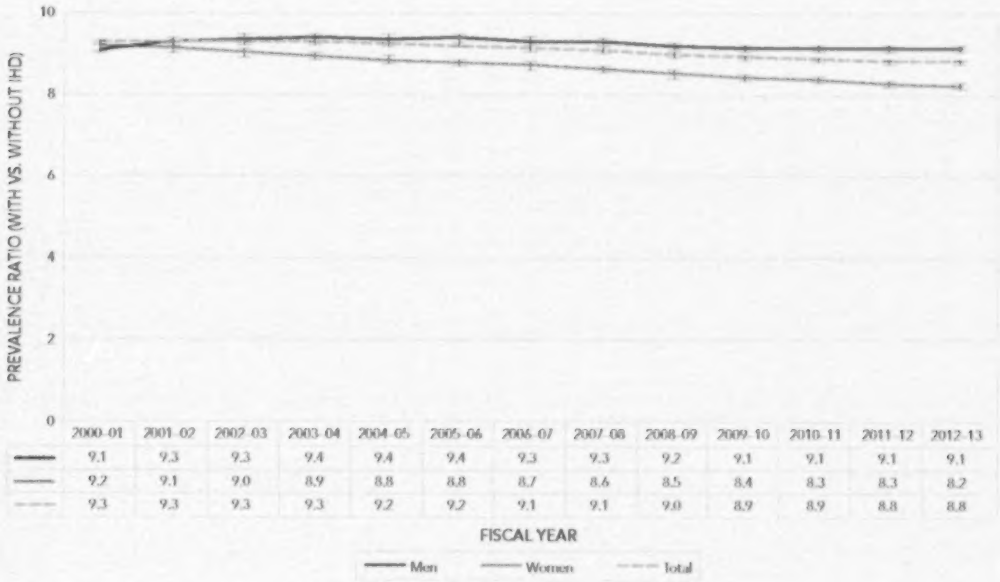


* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

FIGURE 19. Age-standardized[†] prevalence ratio of diagnosed heart failure among Canadians aged 40 years and older with and without diagnosed ischemic heart disease (IHD), Canada*, 2000–2001 to 2012–2013



	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Men	9.1	9.3	9.3	9.4	9.4	9.4	9.3	9.3	9.2	9.1	9.1	9.1	9.1
Women	9.2	9.1	9.0	8.9	8.8	8.8	8.7	8.6	8.5	8.4	8.3	8.3	8.2
Total	9.3	9.3	9.3	9.3	9.2	9.2	9.1	9.1	9.0	8.9	8.9	8.8	8.8

† Age-standardized to the 2011 Canadian population.

* Data from Yukon were not available.

NOTES: The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

SOURCE: Public Health Agency of Canada, using Canadian Chronic Disease Surveillance System data files contributed by provinces and territories, May 2016.

CLOSING REMARKS

The findings included in this report provide an overview of heart disease profiles and trends in Canada. Advancements in the prevention and management of heart disease are reflected by the declining incidence and all-cause mortality rates between 2000–2001 and 2012–2013. Heart disease death rates have declined rapidly over the last few decades. In fact, heart disease, which used to be the leading cause of death in Canada, has now become the second cause of death after cancer, starting in 2007.[39]

Specifically, this report indicates that Canadians with ischemic heart disease (IHD) and heart failure are surviving longer, as shown by the relatively steady prevalence and decreasing incidence and all-cause mortality rates over time. Nonetheless, the burden is substantial, with about 2.4 million Canadian adults living with IHD in 2012–2013, including 578,000 Canadians who had an acute myocardial infarction (AMI), and about 670,000 living with heart failure. The absolute number of Canadians living with these conditions is increasing over time, likely due to the aging of the population, population growth as well as improved survival of those affected. Men are more likely than women to have IHD and heart failure or to have an AMI. However, among those who had an AMI, women younger than 75 years old are more likely to die of any cause than men of the same age in a given year. In addition, the vast majority (71%) of Canadians aged 40 years and older with heart failure also have IHD. Since IHD is the main risk factor for heart failure, prevention of IHD would likely reduce incident heart failure.

Heart disease can be prevented by targeting lifestyle risk factors, such as, smoking, physical inactivity, poor diet, alcohol abuse and risk conditions, namely high cholesterol, obesity, diabetes, and hypertension. The ongoing monitoring of these risk factors and conditions is important in order to inform the development of public health interventions aiming to prevent heart disease and improve disease management.

ONLINE RESOURCES

Interactive Data Tools
Heart Disease Information

APPENDIX A

CANADIAN CHRONIC DISEASE SURVEILLANCE SYSTEM

The Canadian Chronic Disease Surveillance System (CCDSS) is a collaborative network of provincial and territorial chronic disease surveillance systems, led by the Public Health Agency of Canada (PHAC). Its aim is to foster the collection of surveillance data in a consistent and comparable way across all provinces and territories. PHAC uses data from the system to describe epidemiological trends and profiles of chronic diseases and conditions in Canada. The CCDSS has expanded from its initial mandate of diabetes surveillance to include data on several additional chronic diseases and conditions including: hypertension, mental illness, mood and anxiety disorders, asthma, chronic obstructive pulmonary disease, heart failure, ischemic heart disease, acute myocardial infarction, stroke, arthritis, osteoporosis, and some neurological conditions. It is guided by the expertise of the CCDSS Science Committee, with representatives from each province and territory.

The CCDSS identifies chronic disease cases from provincial and territorial administrative health databases, including **physician billing claims** and **hospital discharge abstract records**, linked to provincial and territorial **health insurance registry records** using a unique personal identifier. Data on all residents eligible for provincial or territorial health insurance (about 97% of the Canadian population) are captured in the health insurance registries; thus, the CCDSS coverage is near-universal. Not included in the CCDSS are Canadians covered under federal health programs such as refugee protection claimants, full-time members of the Canadian Forces, eligible veterans, individuals in the Royal Canadian Mounted Police, and federal penitentiary inmates.

APPENDIX B

HEART DISEASE CASE DEFINITIONS

This report features data on insured individuals **'diagnosed'** with ischemic heart disease (IHD), including those who had an acute myocardial infarction (AMI), or heart failure. **'Diagnosed'** refers to people who have met one of the case definitions defined in Table 1 below.

The disease case definitions were developed based on a review of the literature, validation studies,[40,41] feasibility studies,[42,43] national pilot study results, and recommendations from the Canadian Chronic Disease Surveillance System (CCDSS) Heart Disease Working Group. Hospital discharge abstract records and physician billing claims were used for case ascertainment of IHD and heart failure. Case ascertainment of AMI was based on hospital discharge abstract records only. The recommended case criteria were applied for those who were 20 years of age or older for IHD and AMI, and 40 years of age or older for heart failure. The case date of identification for IHD and heart failure was the date of inpatient hospital separation or the last physician visit, whichever came first. The case date of AMI identification was the date of the hospital admission. The denominator for the rate and proportion calculations in the report was the number of individuals in the provincial and territorial health insurance registries. Individual demographic information (i.e. age, sex, province or territory of residence and date of death, if applicable) is obtained from these registries; age is calculated as of the end of the fiscal year, on March 31.

TABLE 1. Case definitions of ischemic heart disease (IHD), acute myocardial infarction (AMI), and heart failure (HF)

CONDITION (AGE)	CASE DEFINITION	ICD* CODES
IHD (20+)	At least one hospital separation listing a diagnostic or procedure code for IHD in any diagnostic field **OR** At least two physician billing claims listing a diagnostic code for IHD in any diagnostic field in a one-year period	ICD-9/ICD-9-CM[†]: 410-414 36.01, 36.02, 36.05, 36.10-36.19 ICD-10-CA[‡]: I20-I25 CCP[††]: 48.02, 48.03, 48.11-48.19 CCI[§]: 1.IJ.50, 1.IJ.57.GQ, 1.IJ.54, 1.IJ.76
AMI (20+)	At least one hospital admission listing a diagnostic code of AMI in diagnostic types M, W, X, Y, 1, or 2[55]	ICD-9/ICD-9-CM: 410 ICD-10-CA: I21-I22
HF (40+)	At least one hospital separation listing a diagnostic code of HF in any diagnostic field **OR** At least two physician billing claims listing a diagnostic code of HF in any diagnostic field	ICD-9/ICD-9-CM: 428 ICD-10-CA: I50

*ICD = International Classification of Diseases; †CM = Clinical Modification; ‡CA = Canada; ††CCD = Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures; §CCI = Canadian Classification of Health Interventions; ¶Type M = The one diagnosis or condition that can be described as being most responsible for the patient's stay in hospital; types W, X, Y = service transfer diagnosis type (W), (X), (Y) code associated with the first/second/third service transfer; Type 1 = condition that existed prior to admission, has been assigned an ICD-10-CA code and satisfies the requirements for determining comorbidity; Type 2 = condition that arises post-admission, has been assigned an ICD-10-CA code and satisfies the requirements for determining comorbidity.[44] Quebec submits all diagnostic types instead of M,W,X,Y,1,2.

APPENDIX C

METHODS

All provinces and territories started identifying cases in their databases as of 1995–1996; with the exception of Quebec which began in 1996–1997 and Nunavut which began in 2005–2006. Data from Yukon were not available for this report. Estimates in this report refer to data from fiscal years 2000–2001 to 2012–2013. For the 365-day all-cause AMI mortality indicator, the latest year of data (i.e. 2012–2013) is not included to ensure that individuals who had an AMI have an equal opportunity to be followed up for a full 365-day period.

Given that historical information was not available prior to fiscal year 1995–1996, the first hospitalization with an AMI diagnostic code during the 2000–2001 fiscal year was considered the start of the index episode. Patients who had been hospitalized for an AMI (ICD-9/ICD-9-CM: 410 or ICD-10-CA: I21–I22) in the five years before their admission in 2000–2001 were excluded to avoid classifying previously prevalent cases as incident cases. Occurrence rate of first AMI was approximated by first-time AMI hospitalization. This indicator took into account whether someone had a prior history of hospitalized AMI and only included those who were experiencing their first-time hospitalized AMI during the surveillance period.

The 2011 Canadian standard population was used for age standardization and 95% confidence intervals were computed using an inverse gamma distribution. Where indicated, data with a coefficient of variation between 16.6% and 33.3% should be interpreted with caution. Data with a coefficient of variation greater than 33.3% or cells with less than 10 counts are not reported.

In order to determine whether differences between each respective province/territory estimates and the pan-Canadian estimate were statistically significant, a Z-test was conducted. P-values less than 0.001 were considered statistically significant.

Random rounding was applied to eliminate the possibility of residual disclosure when reporting data with small cell sizes.[45] Random rounding was applied to all counts presented in the text, tables and figures. For Ontario and Canada, the counts were rounded to the nearest 10. For all the other provinces and territories, the counts were rounded to the nearest 5. Crude estimates were calculated after random rounding while age-standardized estimates were calculated using non-rounded counts. Numbers presented in the text of the report were rounded to the nearest hundred thousand or the nearest hundred, where relevant.

APPENDIX D

LIMITATIONS

The main limitations of the Canadian Chronic Disease Surveillance System (CCDSS) are described below.

First, findings within this report likely underestimate the true burden of heart disease in Canada. Data on other heart conditions such as atrial fibrillation and peripheral vascular disease are not included in the CCDSS.

Second, only data of people who have sought care are included in the CCDSS. Therefore, people who do not seek medical care are not captured; for example, those who are undiagnosed, those who are diagnosed prior to the observation period but do not require regular care because their condition is well managed, or those who die of a heart attack prior to being admitted to the hospital and receiving a diagnosis. More cases could be identified through investigating cause of death in vital statistics, but this data source was not available in all provinces and territories. Sensitivity analyses conducted in Nova Scotia and Quebec found that capturing fatal acute myocardial infarction (AMI) events using vital statistics would increase rates of first-time AMI by 16% in Nova Scotia (unpublished results) and 22% in Quebec.[46] Thus, trends presented in this report might underestimate the true occurrence of AMI in Canada.

Third, the CCDSS may underestimate the burden of heart disease as it relies partly on the physician billing claims database to identify cases. One of the limitations of this database is that physicians not paid on a fee-for-service basis are not always required to submit medical claims. Other payment schemes include salary, contract, capitation and partial fee-for-service. Alternative payment of physicians is more frequent for some specialties, in remote areas and for some primary health care centres. However, in some jurisdictions, physicians under alternative payment schemes are still expected to remit service information, otherwise known as "shadow billing". Both fee-for-service claims and shadow billing were included where available. Services for non-fee-for-service physicians who do not shadow bill are not captured. Currently, it is not possible to establish the magnitude of this impact at the national scale; further studies are required.

Fourth, as with any surveillance system, there is the potential for false positives (wrongly identifying someone as having the disease when the person does not) and false negatives (wrongly identifying someone as not having the disease when the person does). However, the case definitions used to identify heart disease cases were validated and selected in order to minimize the number of false positives and false negatives.

Finally, some individuals have a valid health insurance number in more than one province or territory during a year because of immigration or emigration and they are included in each of the provincial or territorial insured population.

GLOSSARY

Acute myocardial infarction (AMI): A manifestation of ischemic heart disease, AMI refers to a reduction or sudden loss of blood supply to a part of the heart muscle leading to tissue death.

Age-standardized rate or proportion: A rate or proportion adjusted for the differences in population age structure between the study population and a reference population. Age-standardized rates or proportions are commonly used in trend analysis or when comparing rates for different geographic areas or different subgroups.

All-cause mortality: Mortality due to any cause of death occurring during a given period of time.

Angina pectoris: A symptomatic manifestation of ischemic heart disease, describing a severe squeezing or pressure-like thoracic pain, brought on by exertion or stress, usually lasting less than 30 minutes at a time. An increase in frequency or occurrence at rest especially at night is called unstable angina and may indicate an increased risk of a heart attack. It is often referred to simply as angina.

Average annual percent change (AAPC): The average annual percent change over several years is used to measure the change in proportions or rates over time. The calculation involves fitting a straight line to the natural logarithm of the data when it is displayed by calendar or fiscal year. The slope of the line, expressed in percentages, represents the annual percent change.

365-day all-cause mortality: Mortality due to any cause of death, within 365 days of a hospitalization listing a diagnostic code of acute myocardial infarction.

Cardiac arrhythmia: A loss of rhythm of the heart beat which becomes irregular.

Comorbidity: Coexisting diseases or conditions which are additional to a specific disease or condition under study.

Confidence intervals (CI): A statistical measurement of the reliability of an estimate. The size of the confidence interval relates to the precision of the estimate with narrow confidence intervals indicating greater reliability than those that are wide. The 95% confidence interval shows an estimated range of values which is likely to include the true value 19 times out of 20.

Disability-adjusted life year (DALY): A measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death. It can be used to compare the overall health and life expectancy in different countries.

Fee-for-service: Payment of claims based on submission of individual medical services.

Heart failure: A chronic condition occurring when the pumping action of the heart cannot provide enough blood to the rest of the body as it is needed. This can happen as a result of damage to the heart muscle, for example from a heart attack, or from excessive consumption of alcohol, or because of a heart muscle disease which is also called a cardiomyopathy.

Hospital separation: A hospital separation is the departure of an inpatient from hospital, either due to a discharge or death. Hospital separation records are completed by hospitals for each patient who is discharged or who dies in hospital. Hospital separation records provide data on the relative frequency of a disease and the trends in morbidity from it.[47]

Incidence: The number of new cases of a disease or condition occurring in a given time period in a population at risk, expressed as a proportion or rate.

Insured population: The total number of individuals who had a valid health insurance number within a selected province or territory at any point during the selected year. Individuals who had less than a full year of coverage, due to immigration, emigration, birth, or death during that year are included in the population.

International Classification of Diseases (ICD) code: An international standard diagnostic classification for diseases and other health conditions for epidemiological, clinical and health management purposes. For example, it is used to monitor the incidence and prevalence of diseases and other health problems, proving a picture of the general health situation of countries and populations.[48]

Ischemic heart disease (IHD): Also referred to as coronary heart disease, a chronic condition in which the heart muscle is damaged or works inefficiently due to the absence or relative deficiency of its blood supply.

Morbidity: Any departure, subjective or objective, from a state of physiological or psychological well-being.

Non-communicable disease: Non-communicable (or chronic) diseases are diseases of long duration and generally slow progression that are not caused by infectious agents (are not passed from person to person).

Occurrence: Refers to the occurrence of the disease. The occurrence measure must be understood as a proportion between two quantities. Depending on the quantity appearing in the denominator, it is either expressed in percent or per 1,000 in this report. It is only used in this report to refer to the occurrence of acute myocardial infarction.

Prevalence: The frequency of a disease or condition in a population during a defined period of time expressed as the proportion of that population that has the disease or condition. Prevalence provides a measure of the burden of the disease or condition in the population.

Prevalence ratio: The ratio of two prevalence measures. For example, the prevalence of a disease or condition among people with diagnosed heart failure compared to those without diagnosed heart failure.

Rate ratio: The ratio of two related measures. For example, the all-cause mortality rate among those with diagnosed heart failure compared to the all-cause mortality rate among those without diagnosed heart failure.

Relative percent change: A measure of relative change expressed as a percentage. It can be used to demonstrate how much a prevalence estimate at the end of a surveillance period increased or decreased relative to the estimate at the beginning of a surveillance period.

Shadow billing: An administrative process whereby salaried physicians submit service provision information using provincial and territorial fee codes, even though they are reimbursed by other means of payment. Shadow billing can be used to maintain historical measures of service provision based on fee-for-service claims data.

Standard population: A population structure that is used to provide a constant age distribution, so that the rates or proportions of different study populations can be adjusted for comparison (see age-standardized rate or proportion).

Years of life lost: Number of years of life "lost" when a person dies "prematurely" from any cause—before age 75. A person dying at age 25, for example, has lost 50 years of life.[49]

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